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(54) Title: DELIVERY SYSTEM BASED ON A DISPERSION OF AN EMULSIFIER IN AN AQUEOUS SOLUTION OF SUGAR

(57) Abstract

Disclosed and claimed is the use of a sugar such as mono- and/or disaccharide in an aqueous solution as a vehicle for delivery of at least one emulsifier, as well as emulsifier delivery systems, emulsifier dispersions, products therefrom, and methods for making and using the delivery systems, dispersions and products. The emulsifier is hydrated and is in the form of alpha gel in the dispersion. The dispersion has shelf stability with respect to maintaining the alpha gel, as well as with respect to microbial activity and mold. Products from the dispersion exhibit improved shelf stability. Inventive dispersions can contain about 15 to about 40 weight % emulsifier, e.g., about 26 to about 30 weight % emulsifier, about 42 to about 65 weight % sugar, and about 10 to about 20 weight % water. The emulsifier can be a mono-diglyceride. The sugar can be dextrose or high fructose corn syrup.

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TITLE OF THE INVENTION

DELIVERY SYSTEM BASED ON A DISPERSION OF AN EMULSIFIER IN AN AQUEOUS SOLUTION OF SUGAR

FIELD OF THE INVENTION

The present invention relates to a delivery system for emulsifiers, emulsifier dispersions employing the delivery system, and methods for making and using and uses of the delivery system and the emulsifier dispersions.

The present invention also relates to an aqueous sugar or sugar alcohol, e.g., mono- and/or disaccharide delivery system for emulsifiers, emulsifier dispersions employing the delivery system, and methods for making and using and uses of the delivery system and the emulsifier dispersions.

In addition, the present invention relates to an alpha gel emulsifier dispersion obtainable from combining at least one emulsifier, at least one sugar or sugar alcohol such as at least one mono- and/or disaccharide, and water.

The invention further relates to stabilizing the emulsifier dispersion, preferably alpha gel emulsifier dispersion, obtainable from combining at least one emulsifier, at least one sugar or sugar alcohol such as at least one mono- and/or disaccharide, and water, that is, to maintain longer interplanar spacing of the emulsifier bi-layer (in the alpha gel), to thus obtain a hydrated emulsifier system having longer shelf life or greater storage.

The hydrophilic groups of the emulsifier or emulsifiers are exposed in the dispersion. That is, the stabilization provides for greater exposure of the hydrophilic groups than in shortening and conventional emulsifier dispersions. The inventive dispersion is homogenous, not heterogeneous or lumpy, and provides surprising benefits including any or all of: allowing a food manufacturer to use liquid or non-crystal shortening, allowing the use of a wider range of emulsifiers in food preparation, allowing the use of

an emulsifier system with dry ingredients, improved functionality of known emulsifiers cost reduction in the preparation of foodstuff, and stability both functionally (the phase remains stable for increased periods, including in certain applications at least eight(8) months to a year or longer) and microbially (no microbial growth, and no need to acidify food to prevent mold or microbial growth).

Various documents are cited in the following text. Each of the documents cited herein, and each of the references cited in each of those various documents, is hereby incorporated herein by reference. None of the documents cited in the following text is admitted to be prior art with respect to the present invention.

BACKGROUND OF THE INVENTION

Amphiphilic emulsifiers, i.e., having both lipophilic and hydrophilic properties such as food emulsifiers, for instance, polar lipids based on partial esters of glycerides or alcohol with fatty acid and/or organic acids such as edible organic acids, e.g., lactic, diacetylated tartaric, acetic and the like, possess some degree of surface activity depending on factors such as chemical composition, e.g., esterification of monoglycerides with organic acids, changes in fatty acid radicals with respect to chain length or degree of unsaturation (See generally J. Birk Lauridsen, "Food Surfactants, Their Structure And Polymorphism," Technical Paper TP 2-1e, Danisco Ingredients, Brabrand Denmark, and references cited therein; N. Krog, "Interactions of Surface-Active Lipids With Water, Protein and Starch Components In Food Systems," Technical Paper TP 3-1e, Danisco Ingredients, Brabrand, Denmark, and references cited therein; N. M. Barford, "The Influence of Emulsifiers and Hydrocolloids on Fat Crystallisation and Water Binding in Various Food Systems," Technical Paper TP 4-1e, Danisco Ingredients, Brabrand, Denmark, and references cited therein; N. Krog, "Dynamic and Unique Monoglycerides," Technical Paper TP 8-1e, Danisco Ingredients, Brabrand, Denmark, and references cited therein).

A molecule in an emulsifier may be visualized as a hydrophobic tail ending in a

hydrophilic head. It can be further visualized that in the emulsifier, the molecules arrange themselves such that hydrophobic tails of different molecules tend towards being proximate to each other, and hydrophilic heads towards being proximate to each other, with the distance between proximate heads known as the short spacing and the distance between distal heads (going head of first molecule through tail of first molecule and tail of further molecule to head of further molecule known as the long spacing (See Lauridsen, Technical Paper TP 2-1e, *supra*).

Emulsifiers are generally more lipophilic, i.e., more soluble in lipids than water, and thus, cannot dissolve in water or are only sparingly soluble in water, i.e., emulsifiers have limited dispersion properties in water. Accordingly, emulsifiers have been used by providing them in powder form or dissolving them into a fat (shortening)

The provision of emulsifiers in powder form is disadvantageous at least because of the problems of shipping and handling. Powders produce dust which must be contained. Furthermore, powders are more difficult to dose than liquids and for this reason are not favoured by users.

Dissolution of emulsifiers into a fat (shortening) is disclosed in e.g., Hirschey et al., U.S. Patent No. 5,154,942 relating to shortening mixed with an emulsifier, e.g., polyglycol ester/alkali stearoyl lactylate, and sugar, which is then blended with sugar, starch and water to make a creme; Cooper, U.S. Patent No. 3,533,802 providing a mixture of shortening, sugar and emulsifier; WO 70/73692.

A problem in the art is that it can takes an extended period of time for emulsifiers delivered by shortening to become hydrated. For instance, an emulsifier in a shortening delivery system must be mechanically and/or thermally randomized to expose hydrophilic groups, e.g., by stirring and/or elevating temperature of the shortening emulsifier delivery system. It would be desirable to have an aqueous emulsifier dispersion system.

A further problem with shortening emulsifier delivery systems is that there are only a limited variety of emulsifiers provided in such delivery systems due to limitations in the manufacture thereof. For instance, such systems must be prepared in large batches to be economically feasible; and therefore, variety in the emulsifiers provided by such systems is limited. It would be desirable to provide an aqueous emulsifier dispersion system which allows it to be economically feasible for different emulsifiers to be incorporated therein.

Emulsifiers, such as food emulsifiers, can form, under certain conditions, e.g., ion concentration, electrolyte concentration, and temperature, liquid crystalline mesophases (lipid-water phases or lamella dispersions) (See generally Lauridsen, Technical Paper TP 2-1e, *supra*; N. Krog, Technical Paper TP 3-1e, *supra*).

In the presence of water, there is a tendency to hydrate polar heads of the emulsifier molecule while hydrocarbon chains are kept together in bi-layer regions separated by the water, until the KRAFFT temperature is achieved. When achieved, fatty hydrocarbon chains begin to get liquidity; they rotate; and, allow water molecules to penetrate (See generally N. Krog, Technical Paper TP 3-1e, *supra*). Mesophases can be readily dispersed when used.

Emulsifiers delivered by shortening cannot readily form mesophases because of the fat environment, thus presenting a further problem in the art with respect to shortening delivery systems.

Thus, heretofore the use of sugar, especially at least one mono- and/or disaccharide as a delivery system for at least one emulsifier, as herein, has not been taught or suggested.

In certain applications such as in bakery applications it is also desirable to use emulsifiers which are solidified into an alpha crystal form. Upon cooling, lamella dispersions form alpha gel wherein the lipid bilayers are still separated by water layers but the fatty acid hydrocarbon chains are now solidified into an alpha crystal form.

These alpha gels are typically metastable and must be used shortly after their manufacture because after a short period of time they restructure, causing a decrease in functionality. Accordingly, a further problem in the art is that alpha gels have only short term storage stability or a low shelf life. It would be desirable to have hydrated emulsifier systems with a longer shelf life.

A related problem is that these gels cannot form when emulsifiers are incorporated within food applications. It would be desirable therefore to provide an emulsifier system in a food application that is hydrated and is in the alpha gel. It would then be possible to maintain the alpha gel within the food application and provide enhanced emulsification and aeration properties.

A crystal composition (see, e.g., JP 56032955) which is not a hydrated emulsifier system involving the alpha gel does not address the problems in the art by way of an alpha gel as herein. Emulsifier systems which involve polysaccharides (see, e.g., El-Nokaly, U.S. Patent No. 5,215,757) or an oligosaccharide such as maltitoligosaccharide (also known as maltitol; see, e.g., JP 61249992) suffer from deficiencies or do not address the problems in the art as herein since the polysaccharides or oligosaccharides affect the alpha gel structure; for example the long and short spacing is affected from such bulky molecules moving with into spacings between emulsifier molecules. Polysaccharides or oligosaccharides cannot reduce the activity of water with respect to the emulsifier; for instance, due to the size of the polysaccharides or oligosaccharides.

The use of sugar or sugar alcohols in foodstuff compositions (see, e.g., WO 89/038455, WO 79/44621, Food Product Development 1979, 13(10), 60, 62, 64 (Hartnett, D.I.; ICI Americas)), for instance as a sweetener (see, e.g., EP 558523) does not address the problems in the art by way of an alpha gel as herein; for instance, such compositions do not teach or suggest employing sugar and the delivery system as herein, e.g., fails to recognize using sugar to form and/or stabilize the alpha gel. Furthermore, the use of polyols as a humectant (see, e.g., EP218277) fails to address the problems in the art by

way of an alpha gel as herein; for example, there is no teaching, suggestion or recognition of any preference or superiority of mono- and/or disaccharides for use in forming and/or stabilizing the alpha gel over other polyols, e.g., polydextrose, propylene glycol, glycerol.

Thus, heretofore the use of sugar, especially at least one mono- and/or disaccharide as a delivery system for at least one emulsifier in an alpha gel, i.e., to form and/or stabilize at least one emulsifier in an alpha gel, as herein, has not been taught or suggested.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the invention to provide any or all of: a delivery system for at least one emulsifier, emulsifier dispersions employing the delivery system, and methods for making and using and uses of the delivery system and the emulsifier dispersion, such as those which address one or more of the problems in the art; for instance, to provide an aqueous sugar, e.g., mono- and/or disaccharide, delivery system for at least one emulsifier, an aqueous dispersion of at least one emulsifier, and methods for making and using and uses of the delivery system and the dispersion, especially such dispersions which exhibit stability both functionally (remain stable for of the order of 1-2 weeks) and microbially (no microbial growth, and no need to acidify food to prevent mold or microbial growth).

Accordingly, the present invention provides a delivery system for at least one emulsifier comprising an aqueous solution of at least one sugar, advantageously a sugar which reduces water activity or has strong water-binding properties, preferably a mono- and/or disaccharide, more preferably at least one monosaccharide, e.g., dextrose (glucose), sucrose, fructose, mannose, galactose, maltose, lactose, and the like. Dextrose and high fructose corn syrup are presently considered advantageous to use in the practice of the invention.

Instead of a mono- and/or disaccharide, a derivative thereof, such as a sugar alcohol,

e.g., an alditol, a pyranose or an ester or ether, e.g., a C_1-C_6 alkyl ester or ether, may be used in the practice of the invention; but, the derivation should not substantially increase the size of the mono- and/or disaccharide or decrease its ability to reduce water activity. Further, edible mono- and/or disaccharides or derivatives thereof are preferred in the practice of the invention.

The sugar can be present in an amount of about 20 to 80 weight percent, e.g., about 30 to 70 weight percent, such as about 40 to 65 weight percent, e.g., about 42 to about 65 weight percent, such as about 40 to about 55 weight percent, e.g., about 45 to about 55 weight percent, such as about 50 to about 54 or 55 weight percent.

Further, the emulsifier is advantageously an emulsifier which is an alpha tending emulsifier such as polyglycerol esters, propylene glycol esters or sorbitan monostearate. Preferred emulsifiers consist essentially of monoglycerides or mono-diglycerides such as distilled monoglycerides or mono-diglycerides (e.g., total monoglyceride content of 90% minimum such as DIMODAN® manufactured and distributed by DANISCO INGREDIENTS, e.g., DIMODAN LS® which are monoglycerides from sunflower oil).

The emulsifier can be present in an amount of about 15 to about 40 weight percent, e.g., about 25 to about 40 weight percent, such as about 25 to about 35 weight percent, e.g., about 25 or 26 weight percent to about 30 weight percent.

Water in the inventive delivery system can be present in an amount of about 10 to about 20 weight percent (the balance between the amounts of emulsifier(s) and sugar(s) to be 100 weight percent).

Thus, the invention comprehends the use of a sugar as a delivery system for an emulsifier, wherein the sugar is any one or more of a monosaccharide, a disaccharide, a derivative of a monosaccharide, or a derivative of a disaccharide.

The delivery system may be for at least one emulsifier in hydrated form having an alpha

gel structure. The invention thus provides the use of an aqueous solution of at least one mono- and/or disaccharide for delivery of at least one emulsifier in hydrated form having an alpha gel structure.

The present invention further provides an aqueous dispersion of at least one emulsifier comprising the at least one emulsifier, water and at least one mono- and/or disaccharide. The inventive dispersion is homogeneous, not heterogeneous or lumpy.

The present invention even further provides a foodstuff obtainable from or prepared with the inventive emulsifier delivery system or emulsifier dispersion. The invention thus provides the use of the inventive emulsifier delivery system or emulsifier dispersion in the preparation of a foodstuff.

The invention advantageously allows for use of the delivery system with a foodstuff, such as a flour-containing foodstuff, as the water does not migrate to the constituents of the foodstuff, such as the flour, and make it go bad (spoil). The foodstuff also can be a frosting, a creme filling, a dressing, Béchamel sauce or the like.

The invention allows the manufacturer of a foodstuff to use liquid or non-crystal shortening, and a wider range of emulsifiers in the preparation of a foodstuff. Further, the invention may reduce the cost of the foodstuff.

For instance, in the preparation of flour-containing products such as breads, cakes, and the like, it has been observed that the invention provides a foodstuff which has softer crumbs, greater volume, and greater air cell stability, such that less emulsifier and flour are needed to prepare the foodstuff. Also, the foodstuff stays fresh longer, i.e., does not get firm or stale as quickly as control foodstuffs prepared without the invention. Indeed, an increase in freshness of three (3) to five (5) days or more has been observed in flour-containing foodstuff prepared with the instant invention. It is believed, without necessarily wishing to be bound by any one particular theory, that this observation is due to the alpha gel remaining intact, or otherwise advantageously interacting with

ingredients, e.g., protein, starches, etc. in the foodstuff.

Additionally, the invention allows the food manufacturer to not have to use the emulsifier system immediately or shortly after preparation or to acidify to prevent mold or microbial growth, as the invention has functional stability (stability of the order of 1-2 weeks or in one embodiment stability of at least eight (8) months to a year or longer without loss of the alpha gel) and microbial stability (no observed mold or growth after eight (8) months to a year or longer).

In certain embodiments the invention provides a hydrated emulsifier system comprising or consisting essentially of: 15 to 60 weight percent of at least one emulsifier, 42 to 65 weight percent of at least one sugar, wherein the sugar is predominantly comprised of mono and/or disaccharides, and 10 to 20 weight percent of water.

The sugar of the system of the present invention is preferably dextrose or high fructose corn syrup.

The emulsifier is preferably comprised predominantly of or consists essentially of monoglycerides or mono-diglycerides. The sugar is preferably dextrose or high fructose corn syrup. In certain embodiments the at least one emulsifier can comprise or consist essentially of an ionic co-emulsifier and an emulsifier, preferably an alpha-tending emulsifier. A preferred ionic co-emulsifier is DATEM, DIMODAN®, GRINDSTED™ or sodium stearoyl lactylate, and the (alpha tending) emulsifier is preferably polyglycol ester(s), propylene glycol ester(s), or sorbitan monostearate. The emulsifier can be present in an amount of about 25 to about 40 weight percent, e.g., about 25 to about 35 weight percent, such as about 25 or about 26 weight percent to about 30 weight percent.

The invention also comprehends a method for preparing an emulsifier system or a hydrated emulsifier, advantageously a hydrated emulsifier having an alpha gel structure, comprising admixing the at least one emulsifier, the at least one sugar and, optionally, water at a suitable temperature for formation of the lamella mesophase. The suitable

temperature may chosen depending on the melting properites of the emulsifier, for example an emulsifier which is liquid at room temperature may be admixed at room temperature. In one alternative, the admixture may be prepared at for example, about 55° to about 80°C. The method can comprise blending the emulsifier at about 55° to about 80°C, preferably about 60° to about 80°C and adding the sugar and water with mixing at a temperature of about 55 to about 80°C. The sugar and water are added in an amount to establish an emulsifier content of about 25 to about 40 weight percent, e.g., about 25 or 26 to about 30 weight percent. The mixture is then cooled to a suitable temperature, for instance to about room temperature (e.g., about 20° to about 25°C), for alpha gel formation.

Given that water and a mono- and/or disaccharide are the vehicle for delivering the emulsifier, and the elegant simplicity in the preparation of the system, the invention provides an opportunity for a variety of different emulsifiers to be used in the emulsifier system, providing foodstuff manufacturers with emulsifier options not heretofore provided by shortening delivery systems.

Accordingly, the invention further comprehends methods for making a foodstuff comprising using the inventive dispersion system. For instance, in preparing a foodstuff the inventive emulsifier can be plated onto dry ingredients, and thereafter the additional ingredients of the foodstuff can be added, and the foodstuff prepared as is typical for the preparation of the particular foodstuff.

These and other embodiments are disclosed or are obvious from and encompassed by, the following Detailed Description.

DETAILED DESCRIPTION

Emulsifiers are typically delivered into food systems (e.g., cakes, fillings, icings etc.) via shortening systems. This is done because emulsifiers are typically more lypophilic (fat loving) than hydrophilic (water loving) and therefore are soluble or at least partially

soluble in fats and oils. Unfortunately, as discussed herein, emulsifiers delivered in via a shortening system do not always function optimally as their activity as a surfactant or as an aerator is suppressed due to the time required for the emulsifier to become hydrated in such a fat medium. In addition, this mode of delivery can be quite limiting in applications requiring greatly reduced fat or no fat levels. Thus, there are problems with shortening systems for delivery of emulsifiers.

There are also spray congealed emulsifiers. In this mode, an emulsifier or an integrated blend of emulsifiers can be manufactured into a powdered bead form by a process known as spray congealing. That is, the emulsifier system in a molten state is atomized into small droplets which are then passed through a cooling tower initiating crystallization when the necessary temperature is achieved. Generally, such emulsifier systems consist of non-ionic emulsifiers such as distilled monoglycerides in combination with so-called co-emulsifiers which are ionic (e.g., DATEM, sodium stearoyl lactylate, citric acid esters of monoglycerides) to improve wetting properties. In addition, other emulsifiers referred to as alpha tenders are included. These emulsifiers crystallize from the melt in an alpha crystal form with a single chain packing (SCL) where the fatty acids penetrate each other in the hydrocarbon region. Such crystal formations can be characterized by an x-ray diffraction with a short spacing of 4.1 Angstroms. Such emulsifiers have generally large polar head groups and include propylene glycol esters of fatty acids, polyglycerol esters of monoglycerides, sorbitan esters of fatty acids. Emulsifiers demonstrating this behavior provide aerating properties upon hydrating. These crystallized (spray congealed) emulsifiers can then be dry blended with the other ingredients (e.g., flour, sugar, leavening agents) before processing in an industrial preparation or as in a prepackaged mix.

Although designed to hydrate readily in these applications, these spray congealed emulsifier systems must compete with the other components of the blend such as starches, proteins, gums, sugars, etc. for the available water. This competition can reduce the activity of the system as it extends the time required for hydration. This is a problem as extending the time for hydration extends the time for the emulsifier(s) to

complex with starches, to interact with proteins, to interact with other lipids or to reinforce foam structures. Also these systems have shown to be unstable in the alpha crystal form during storage. And, as transition occurs from the alpha crystal to the beta crystal, the emulsifier system will provide less functionality and less aerating. It is somewhat possible for the processor to improve the hydration tendency of these emulsifier systems by first combining with water from the foodstuff recipe with heat to recrystallize back to the alpha crystal form. However this solution requires the food processor to incorporate an additional step in the processing scheme, causing additional time and/or equipment. And, this option to improve hydration is not available for such applications as in retail and food service prepared mixes (i.e. cakes, muffins, brownies) where the water addition is made by the consumer directly to a mix including the emulsifier system. Thus, there are problems with spray congealed emulsifiers.

There are also spray dried emulsifiers on carriers (i.e. bulking agents, milk solids). In this mode, an emulsifier or an integrated emulsifier blend is dispersed in an aqueous solution of, for instance, milk solids in a very controlled environment. This dispersion is then atomized into small droplets which pass through a tower of heated air where the water is removed by evaporation. This process results in a fine powder composed of a carrier encapsulated with the desired emulsifier system. Unfortunately, the processing for the emulsifiers into this form is very energy intensive due to the removal of the water; and this, of course, can be quite expensive. For this reason, the application of emulsifiers in this form is often quite limited; and thus, spray dried emulsifiers on carriers have problems.

There are also hydrated emulsifier systems. In this process, emulsifier(s) in a molten form are dispersed into water using a high intensity mixer (i.e. homogenizer). When the dispersion is cooled below 40 - 45°C an alpha crystalline gel will be formed. In this gel form, the liquid bilayers are still separated by water layers, but the fatty acid hydrocarbon chains are solidified in an alpha crystal form (x-ray short spacing of 4.1 Angstroms). The gel is then treated with an organic or inorganic acid to reduce the pH around 2 or 3 to prevent microorganism growth. In addition, small levels of humectants

(i.e. glycerol, sorbitol, etc.) can also be added to reduce water activity. This crystallized dispersion is then delivered to the food processor where it is first plated onto the dry ingredients. Unfortunately, this mode of delivery also has several disadvantages. For one, a high level of water is being transferred from the manufacturer to the end user which can be quite expensive. Also the incorporation of the acids for pH reduction can greatly hamper the dispersion characteristics of the emulsifiers as the free acid form will exist and this in turn inhibits the desired activity or functionality. In addition, the stability of the alpha crystals in this hydrated dispersion is limited and with time will transform into beta crystals, resulting in a collapse of the water layer separating the lipid bilayers. This transformation will vary depending on storage conditions but generally occurs after at most only a few months. When this occurs, the hydrophilic polar groups on the emulsifiers are no longer as exposed or as accessible, and as a result the functionality is greatly reduced. Thus, previous hydrated emulsifier systems suffered from problems.

Accordingly, it would be desirable to overcome or address the problems of prior emulsifier delivery systems.

This invention allows an alternate delivery of emulsifiers to food applications other than via shortening or the other delivery systems; and, the invention delivers the emulsifier in a highly functional form.

The emulsifier(s) in the inventive delivery system may be stabilized in the alpha crystalline spacing without any degradation for a prolonged period, for example 1-2 weeks or at least eight (8) months. This was analysed by an X-ray diffraction study of the inventive dispersions. With such analysis the short spacing was believed to maintain at 4.1 Angstroms which correlates with the alpha crystalline gel. In addition, analysis of the long spacing was believed to maintain at 50 - 60 Angstroms, which suggests that a minimum 20 - 30% of the bilayer region may be occupied by the liquid sugar (water and sugar molecules). By microscopic evaluation, the inventive dispersions were characterized as being as the alpha crystalline gel dispersed with an

aqueous sugar solution.

Subsequent evaluation of the invention demonstrated that the emulsifiers may be alpha crystalline stable in the gel form as the aqueous sugar solution expands into the bilayer and is maintained. These sugars (e.g., dextrose, fructose, sucrose) provide strong water binding properties, reducing the water activity and thereby stabilizing the system against microorganisms such as mold, yeast growth. In addition, the continuous sugar matrix in the inventive delivery system complements the wetting behavior of the emulsifier, acting very similarly to a protein carrier.

The invention therefore provides the stabilization of the highly functional alpha crystalline phase promoting activity for an extended period of time.

Accordingly, as discussed, the invention pertains to a delivery system for an emulsifier, emulsifier dispersions employing the delivery system, and methods for making and using and uses of the delivery system and the emulsifier dispersions.

More particularly, the invention is the use of at least one mono- and/or disaccharide as a delivery system for at least one emulsifier, preferably in hydrated form having an alpha gel structure.

The delivery system contains an aqueous solution of at least one sugar, advantageously a sugar which reduces water activity or has strong water-binding properties, preferably a mono- and/or disaccharide, more preferably at least one monosaccharide, e.g., dextrose (glucose), sucrose, fructose, mannose, galactose, maltose, lactose, and the like.

Dextrose and high fructose corn syrup are presently considered advantageous to use in the practice of the invention.

Advantageously, the delivery system may contain 60-70 weight % high fructose corn syrup.

Instead of a mono- and/or disaccharide, a derivative thereof, such as a sugar alcohol, e.g., an alditol, a pyranose or an ester or ether, e.g., a C_1-C_6 alkyl ester or ether, may be used in the practice of the invention. In a preferred embodiment, the derivation should not substantially increase the size of the mono- and/or disaccharide or decrease its ability to reduce water activity. Further, edible mono- and/or disaccharides or derivatives thereof are preferred in the practice of the invention. As to typical derivatives of mono- and/or disaccharides and the distinction between (i) mono- and/or disaccharides and (ii) polysaccharides and oligosaccharides, reference is made to Streitweiser and Heathcock, Introduction to Organic Chemistry Chapter 25 (Macmillan Pub. Co. Inc. 1976). Other suitable derivatives of mono- and/or disaccharides useful in the practice of this invention can be ascertained by the skilled artisan without undue experimentation from this disclosure and knowledge of the art of food grade derivatives of mono- and/or disaccharides.

The sugar can be present in an amount of about 20 to 80 weight percent, e.g., about 30 to 70 weight percent, such as about 40 to 65 weight percent, e.g., about 42 to about 65 weight percent, such as about 40 to about 55 weight percent, e.g., about 45 to about 55 weight percent, such as about 50 to about 54 or 55 weight percent.

The present invention is particularly advantageous because it allows for the delivery of a further deliverable substance, i.e a deliverable substance other than the emulsifier. Thus, in an advantageous aspect the delivery system of the present invention comprises an emulsifier and a further deliverable substance.

This aspect is particularly advantageous because one may provide a delivery system comprising an emulsifier and one or more further deliverable substances. Thus a single aqueous system may be provided containing each of the components required for delivery. This is further advantageous in the food industry where a single system may be provided containing each of the required ingredients, preferably functional ingredients, for a recipe. This single system may be dosed into the recipe. Yet further,

one may incorporate powders and liquids in the delivery system. Thus, separate delivery to, storage by and dosage of the power and liquid by the end user is not required.

The further deliverable substance and/or the emulsifier may be in the form of a particulate substance, such as a powder, granulate, pellet or bead. Preferably, the particulate substance has an average particle size of no greater than 800 µm.

When the further deliverable substance is a particulate substance the present invention is particularly advantageous. Many particulate substances such as powders need to be readily dispersible in liquids such as water or milk. In the food industry this is the case in, for example, powdered isotonic sport drinks, instant cocoa powder and protein powders such as Na-caseinates.

Typically, particulate substances such as powders can be rendered dispersible by an agglomeration process or by coating them with a surface active agent. For example, instant cocoa powders are very often coated with high amounts of lecithin (approx. 5% of an ordinary lecithin containing approx. 50% soy bean oil) to render the dispersible. However, this coating may cause off flavour problems due to the oxidation of the soy bean oil (often referred to as the reversion flavour typically for soy bean oil). Moreover, most of the lecithin used worldwide are derived from soy beans. Many supplies of soy beans comprise beans from genetically modified plants. Consumer pressure and legislation renders the use of such beans undesirable or unacceptable. Thus, there is a desire in industries such as the cocoa industry to replace lecithin with other emulsifiers.

The inventive delivery system comprising a particulate substance such as powder is advantageous in that it is readily dispersed. The delivery system provides improved wetting of the particulate substance and therefore more rapid dispersion.

Preferably, the further deliverable substance is selected from the group consisting of hydrocolloids, flavourings, food ingredients, enzymes, gums, starch, vitamins,

sweeteners, functional proteins, salts, stimulants, including caffeine, pharmaceuticals, nutrients, food supplements, lecithin, including purified lecithin, clours, preservative, antioxidants and mixtures thereof.

Preferably, the pharmaceutical is administerable orally.

Food ingredients may be selected from cocoa, herbs, mustard powder, egg powder and mixtures thereof.

Sweeteners may be selected from artificial sweeteners, including saccharin, aspartame (Nutrasweet™), acesulfame-K, thaumatin (Talin™), glycyrrhizin, alitame, dihydrochalcone, miraculin (miracle fruit), morellin (serendipity fruit), steriside, MDs aryl sweetener and mixtures thereof.

The emulsifier is advantageously an amphiphilic emulsifier, preferably a food emulsifier. For instance, the emulsifier can be a polar lipid(s) based on partial ester(s) of glyceride(s) or alcohol with fatty acid and/or organic acid(s) such as edible organic acid(s), e.g., lactic acid, diacetylated tartaric acid, acetic acid and the like. Advantageous emulsifiers include CREMODAN® (manufactured and distributed by DANISCO INGREDIENTS) including CREMODAN® DC, CREMODAN® MOUSSE, CREMODAN® SE, CREMODAN® SI, CREMODAN® SIM, CREMODAN® SL, CREMODAN® TEF; GRINDSTED™ (manufactured and distributed by DANISCO INGREDIENTS), including GRINDSTED™ BK, GRINDSTED™ CITREM, GRINDSTED™ ES, GRINDSTED™ FF, GRINDSTED™ GA, GRINDSTED™ PS such as GRINDSTED™ PS 100, GRINDSTED™ PS 200, GRINDSTED™ PS 300, GRINDSTED™ PS 400, GRINDSTED™ WP; RECODAN™ (manufactured and distributed by DANISCO INGREDIENTS); RYLO™ (manufactured and distributed by DANISCO INGREDIENTS), including RYLO™ AC, RYLO™ CI, RYLO™ LA, RYLO™ MD, RYLO™ MG, RYLO™ PG, RYLO™ PR, RYLO™ SL, RYLO™ SO, RYLO™ TG; DATEM (diacetyl tartaric acid esters of mono-diglycerides), e.g., PANODAN® (manufactured and distributed by DANISCO

INGREDIENTS), CITREM (citric acid esters of monoglycerides) and/or sodium stearoyl lactylate. Thus, the emulsifier can be an ionic emulsifier.

The emulsifier may also be selected from E 420, E 421, E 481-482, E 473, E 474, (5 g/ kg) and mixtures thereof.

Further, the emulsifier is advantageously an emulsifier which is an alpha tending emulsifier such as polyglycerol esters, propylene glycol esters or sorbitan monostearate. Preferred emulsifiers consist essentially of monoglycerides or mono-diglycerides such as distilled monoglycerides or mono-diglycerides (e.g., total monoglyceride content of 90% minimum such as DIMODAN® manufactured and distributed by DANISCO INGREDIENTS, e.g., DIMODAN LS® which are monoglycerides from sunflower oil).

Other emulsifiers which can be used in the practice of the invention include lecithin, acetic acid esters of mono-diglycerides, lactic acid esters of mono-diglycerides, citric acid esters of mono-diglycerides, succinic acid esters of mono-diglycerides, salts of fatty acids, polyglycerol esters of fatty acids, propylene glycol esters of fatty acids, calcium stearoyl lactate, sucrose esters of fatty acids, polysorbate 60, 65, and 80.

For suitable emulsifiers in the practice of the invention, reference is made to J. Birk Lauridsen, "Food Surfactants, Their Structure And Polymorphism," Technical Paper TP 2-1e, Danisco Ingredients, Brabrand Denmark, and references cited therein; N. Krog, "Interactions of Surface-Active Lipids With Water, Protein and Starch Components In Food Systems," Technical Paper TP 3-1e, Danisco Ingredients, Brabrand, Denmark, and references cited therein; N. M. Barford, "The Influence of Emulsifiers and Hydrocolloids on Fat Crystallisation and Water Binding in Various Food Systems," Technical Paper TP 4-1e, Danisco Ingredients, Brabrand, Denmark, and references cited therein; N. Krog, "Dynamic and Unique Monoglycerides," Technical Paper TP 8-1e, Danisco Ingredients, Brabrand, Denmark, and references cited therein. Other emulsifiers commercially available include SOFT TOUCH #640, and KAKE MATE SPECIAL #21.

The emulsifier can be present in an amount of about 15 to about 60 weight percent, such as about 25 to about 40 weight percent, e.g., about 25 to about 35 weight percent, such as about 25 or about 26 to about 30 weight percent.

Water in the inventive delivery system can be present in an amount of about 10 to about 20 weight percent (the balance between the amounts of emulsifier(s) and sugar(s) to be 100 weight percent).

The preferred inventive delivery system is for at least one emulsifier in hydrated form having an alpha gel structure. The invention thus provides the use of an aqueous solution of at least one mono- and/or disaccharide for delivery of at least one emulsifier in hydrated form having an alpha gel structure.

The interplanar spacing of the emulsifier bilayer in the alpha gel formed in the delivery system of the present invention may be characterized by low angle diffraction. The emulsifier dispersions of the invention have demonstrated stability in this spacing for eight (8) months to a year, and longer.

Without wishing to necessarily be bound by any one particular theory, it is believed that the mono- and/or disaccharide molecules become oriented in between the bilayer of the emulsifier molecules. This in turn is believed to prevent the bilayer from collapsing and also allows for better and improved wetting properties of the alpha gel. In this regard, monosaccharides are especially preferred, as monosaccharides provide water management for the emulsifier dispersion which holds the water activity very low. Accordingly, the inventive emulsifier dispersion is also microbially stable, allowing it to be incorporated into dry mixes such as retail cake mixes, without adversely impacting upon the proteins or leavening agents. Thus, foodstuff manufacturing benefits from the inventive emulsifier dispersion.

Thus, the invention entails an aqueous dispersion of at least one emulsifier comprising

the at least one emulsifier, water and at least one mono- and/or disaccharide. The emulsifier is in hydrated form and has an alpha gel structure. The invention accordingly further entails an alpha gel dispersion wherein hydrophilic groups are exposed. The inventive dispersion is homogeneous, not heterogeneous or lumpy.

Furthermore, the invention provides a foodstuff obtainable from or prepared with the inventive emulsifier delivery system or emulsifier dispersion. The invention thus provides the use of the inventive emulsifier delivery system or emulsifier dispersion in the preparation of a foodstuff.

The foodstuff may be selected from baked goods, such as cakes including low fat cakes, bread, sweet dough products, laminated doughs, biscuits and liquid batters; caramels, halawa, ice creams, mousses, whipped dairy creams, whipped vegetable creams, sorbets, aerated and non-aerated whippable products, fillings, oil-in-water emulsions, water-in-oil emulsions, spreads including chocolate spreads, low fat and very low fat spreads, cream margarine, cake margarine, low fat cake margarine; dressings, mayonnaise, dips, emulsified sauces, cream based sauces, emulsified soups, cream based soups, beverages, spice emulsions, meat products including processed meats, emulsified type sausages or combinations thereof.

A particular foodstuff of the invention is a flour-containing foodstuff, such as a dried cake mix, e.g., for preparation of pound cake, or bread. The invention advantageously allows use with flour so that water does not migrate to the flour and make it spoil. Other foodstuffs which can be prepared using the invention include frostings, creme fillings, and the like.

The invention allows the manufacturer of a foodstuff to use liquid or non-crystal shortening, and a wider range of emulsifiers in the preparation of a foodstuff.

The invention allows one to provide an emulsifier without the need to homogenise the emulsifier. Typically, emulsifiers must be melted and homogenised together with a fat

phase in a product to be completely distributed onto the fat globules and thereby become functional. This is often achieved by heating the emulsifier to 65°C to render it functional. The emulsifier of the delivery system of the present invention may be functional at room temperature. Homogenisation, for example by heating, may not be essential. This is particularly advantageous if the emulsifier is to be delivered to a system comprising starch. Starch may be spoilt by homogenisation treatments such as heating.

In a further preferred aspect the emulsifier of the inventive delivery system may be homogenised. In this aspect, the homogenised emulsifier has increased funtionality than a homogenised emulsifier which has been delivered in accordance with the prior art. Moreover, the known advantages of homogenisation by heating such as destruction of bacteria may also be achieved.

The improved functionality of emulsifiers when delivered by the system of the present invention not only provides for enhanced functional behaviour of typically used emulsifiers but also provides for the use of emulsifiers not usually considered active enough for the desired application and for the use of emulsifiers which are usually only active enough for the desired application when at an elevated temperature.

The applicant has found that the delivery system of the present invention may provide:

i) a pumpable delivery system as an alternative to the prior art systems of dry-blended mixtures of emulsifiers and further deliverable substances such as hydrocolloids and integrated functional systems (further deliverable substances such as hydrocolloids melted into the emulsifier phase).

ii) the use of many/all emulsifier types in combination with further deliverable substances such as hydrocolloids in one pumpable system. This contrasts with the prior art in which soft emulsifiers cannot be used in dry-blended mixes of further deliverable substances such as hydrocolloids and emulsifiers and cannot be used in integrated functional systems.

iii) the integration of further deliverable substances such as gums or other ingredients

e.g. flavours in a single delivery system

iv) improved emulsifying properties. The system of the present invention provides a good dispersion of emulsifiers. Thus the emulsifiers are directly functional and can be used in a hot system without homogenisation or in a cold system without heat treatment and homogenisation.

Further, the invention may reduce the cost of the foodstuff. For instance, in the preparation of flour-containing products such as breads, cakes, and the like, it has been observed that the invention provides a foodstuff which has softer crumbs, greater volume, and greater air cell stability. Thus, less emulsifier and flour than without the invention are needed to prepare the foodstuff including the invention. The skilled artisan can adjust recipes without undue experimentation, using the knowledge in the art.

Also, foodstuff, such as flour-containing foodstuff, e.g., cake, bread, prepared with the present invention, stays fresh longer, i.e., does not get firm or stale as quickly as control foodstuffs prepared without the invention. Indeed, an increase in freshness of three (3) to five (5) days or more has been observed in flour-containing foodstuff prepared with the instant invention.

It is believed, without necessarily wishing to be bound by any one particular theory, that this observation is due to the alpha gel remaining intact, or otherwise advantageously interacting with ingredients, e.g., protein, starches, etc. in the foodstuff.

Furthermore, the inventive emulsifier system can be used in the preparation of a foodstuff in conjunction with or in addition to other emulsifier systems. Thus, for example, the inventive emulsifier system can be used in concert with emulsified shortenings to improve functionality. In this way, the invention allows the foodstuff manufacturer several advantages, such as the ability to reduce shortening inventory or shortening use, as well as the ability to employ a greater variety of emulsifiers in the preparation of a foodstuff.

Also, it is noted that the inventive emulsifier system is useful in ordinary doughs, i.e., doughs intended for ordinary (not especially sweetened) breads (in contrast to especially sweetened breads such as Irish Soda Bread or cakes). That is, it is noted that the inventive emulsifier system is useful for delivery of the emulsifier in foodstuffs wherein sweetening of the foodstuff is either not necessary or not desired. And thus, the invention is distinguished from previous uses of sugar or sugar solutions in that previous uses of sugar were for sweetening whereas the sugar in the present invention is used for stabilizing the alpha gel, as sugar molecules replace water molecules in the alpha gel.

Additionally, the invention allows the food manufacturer to not have to use the emulsifier system immediately or shortly after preparation or to acidify to prevent mold or microbial growth, as the invention has functional stability and microbial stability. A stability of eight (8) months to a year or longer without loss of the alpha gel has been observed with the emulsifier dispersion of the present invention with no observed mold or growth after that eight (8) months to a year or longer.

In certain embodiments the invention provides a hydrated emulsifier system comprising or consisting essentially of: 15 to 40 weight percent of at least one emulsifier, 42 to 65 weight percent of at least one sugar, wherein the sugar is predominantly comprised of mono and/or disaccharides, and 10 to 20 weight percent of water. The emulsifier is preferably comprised predominantly of or consists essentially of monoglycerides or mono-diglycerides. This emulsifier composition is particularly preferred when the system is used in the preparation of a bakery product such as bread. The sugar is preferably dextrose or high fructose corn syrup. The emulsifier can be present in an amount of about 26 to 30 weight percent. Thus, inventive dispersions contain about 15 to about 40 weight % emulsifier, preferably about 26 to about 30 weight % emulsifier, about 42 to about 65 weight % sugar, and about 10 to about 20 weight % water.

The method for preparing an emulsifier system or a hydrated emulsifier, advantageously

a hydrated emulsifier having an alpha gel can comprise admixing the at least one emulsifier, the at least one sugar and the water at a suitable temperature for formation of the lamella mesophase, e.g., about 55° to about 80°C. The method can comprise blending the emulsifier at about 55° to about 80° preferably about 60° to about 80°C, and adding the sugar and water with mixing at a temperature of about 55 to about 80°C. The sugar and water can be added in an amount to establish an emulsifier content of about 25 to 40 weight percent, e.g., about 25 or about 26 to about 30 weight percent. The resultant mixture is then cooled to a suitable temperature such as about 20° to about 25°C (e.g., room temperature) for alpha gel formation.

The invention provides an opportunity for a variety of different emulsifiers to be used in the emulsifier system, providing foodstuff manufacturers with emulsifier options not heretofore provided by shortening delivery systems.

The invention accordingly further comprehends methods for making a foodstuff comprising using the inventive dispersion system. For instance, in preparing a foodstuff the inventive emulsifier can be plated onto dry ingredients, and thereafter the additional ingredients of the foodstuff can be added, and the foodstuff prepared as is typical for the preparation of the particular foodstuff.

We have also found that the delivery system of the present invention may deliver the further deliverable substance in such a manner that, if the substance is unstable, it may be protected from degradation. This has particularly found with artificial sweeteners such as aspartame.

Therefore, by this disclosure, the skilled artisan is provided with an advantageous alternative to previous dispersion systems.

The present invention will now be described by way of examples.

EXAMPLES

EXAMPLE 1
PHASE PROPERTIES AND STRUCTURE OF MONOGLYCERIDE-SUCROSE-WATER SYSTEM

This Example is adapted from Soderberg, I. (Department of Food Technology, University of Lund, Box 124, S-221 00 Lund, Sweden) and Ljusberg-Wahren, H. (Swedish Sugar Company, Box 32, S-232 21 Arlov, Sweden), "Phase Properties and Structure of a Monoglyceride-Sucrose-Water System" (in press).

The phase behavior of a sunflower oil, monoglyceride-sucrose-water system was studied at 30°C. The different phases were identified by low-angle X-ray diffraction and polarization microscopy. The main feature of the phase diagram is the transition from a cubic phase to a reversed hexagonal phase (H_{II}) when sucrose is added to the monoglyceride-water mixture. A similar phase behavior was also shown to occur for monoolein-sucrose-water, as well as in the corresponding systems when sucrose was replaced by trehalose, fructose and glucose, respectively.

The phase transition from a cubic phase to a H_{II} phase, when sugar is introduced to a monoglyceride-water system, corresponds to an increased average wedge shape of the lipid molecule. One explanation for this phenomenon is a structural change of the lipid caused by interaction between the sugar and they hydrated polar head group, thus reducing the interfacial area of the polar region at the contact zone with water.

Monoglycerides are "swelling" amphiphiles with low monomer concentration in water. During "swelling" considerable amounts of water are incorporated when the monoglycerides form various liquid crystalline phases.

This Example considers the phase properties and structure of liquid-crystalline phase in the system of sucrose, sunflower oil, monoglycerides and water. Interactions between sugars and monoglycerides in liquid crystalline phases are discussed in relation to the well-known properties of aqueous sucrose solutions and binary monoglyceride-water systems. Monoglycerides are extensively used in the food industry as emulsifiers.

Monoglycerides from sunflower oil (DIMODAN LS®) were supplied by A/S Grindsted, Brabrand, Denmark (DANISCO INGREDIENTS). The sample contained 66% C 18:2, 19% C 18:1 C 16:0 and 5% C 18:0. The content of other fatty acids was below 1%. Monoolein (1-Monooleoyl-rac-Glycerol), 99% purity, was purchased from Sigma.

Sucrose (0.013% (w/w) ash content) was supplied by the Swedish Sugar Company. D(+)-Glucose p.a. and D(-)-Fructose p.a. were obtained from Fluka and D(+)-Trehalose p.a. was obtained from Sigma.

The experimental samples were obtained by mixing appropriate amounts of the technical monoglyceride and sugar solution in 10 ml test tubes with screw caps. The samples were heated in a waterbath (90°C) for 1 min and centrifuged. They were then stored at 50°C for 2 h and finally reheated to 90°C for another minute. The samples were equilibrated for at least 1 week at 30°C. The initial high temperature used was needed in order to melt the most saturated monoglyceride homologues. No increase in monosaccharide content or acid number was detected after the thermal treatment.

Samples of the system containing pure monoolein were obtained by weighing appropriate amounts of monoolein and mixing it with water to form a L_α phase. The samples were stored at 40°C (to melt the monoolein) and subsequently centrifuged (in order to ensure good mixing). Sugar solution was added to the L_α phase. The samples were then allowed to equilibrate at room temperature for 1 week.

All the samples were examined between crossed polarizers for birefringence and

homogeneity. The centrifuge step was repeated during storage until no further change in macroscopic behavior could be seen. When the samples had reached equilibrium, the structure of the different phases was investigated by low angle X-ray diffraction and polarization microscopy.

For the X-ray measurements a DPT camera (Stenhagen) and a Guinier camera after Luzzati (Luzzati et al.), with a quartz monochromater were used. The measurements were performed at 30°C and before the samples had been in equilibrium for one month. An Olympus Vanox microscope was used for polarization microscopy.

There are three liquid crystalline phases with lamellar (L_a), cubic (C) and reversed hexagonal (H_{II}) structure. In addition there are two liquid phases: an oil continuous solution (L2), in the monoglyceride corner, and the aqueous sucrose solution (when plotted in a ternary phase diagram from the results). The H_{II} phase and the L2 phase exist over a larger range of sucrose concentrations than the cubic and the lamellar phases, which exist only with low amounts of sucrose. At a monoglyceride to water ratio of about 85:15% (w/w), a maximum amount of sucrose is incorporated in the H_{II} phase.

The different phases were identified according to their X-ray diffraction characteristics and texture in polarized light. In Table 1 X-ray diffraction data are listed. The H_{II} phase was rather stiff, showing a fan-like texture in the polarization microscope (Rosevear, J. Am. Oil. Chem. Soc.; Rosevear, J. Soc. Cosmetic Chemists).

For samples in the H_{II} one-phase region with constant monoglyceride: water ratio, an approximate "wedge-shape" factor was derived. The hydrophilic components, water and sugar, were regarded as a momogeneous ideal solution. The minimum lipid bilayer thickness was assumed to be constant and the water channels were considered to be cylindrical. The wedge shape factor was defined as the ratio between the cross-section at the end of the hydrocarbon chain and the cross sectional area at the polar head group. The wedge-shape factor, thus defined, had a value of 1.3 at maximum sucrose

concentration.

This behavior of the monoglyceride-sucrose-water system shows that the replacement of water with sucrose produces a transition from a cubic phase to a H_{II} phase. This should be compared with a reduction of water content by dehydration of the cubic phase which produces a transition from a cubic phase to a L_α phase.

For a binary monglyceride-water system an increase in temperature results in a transition from a cubic phase to a H_{II} phase (Lutton et al.; Larsson et al.), which is consistent with an increased average wedge-shape of the amphiphilic molecules from the polar group towards the methyl end group. This is thought to provide a driving force for the transition $C \rightarrow H_{II}$ (Israelachvili et al.), which is thus related to an increased disorder of the hydrocarbon chains towards the methyl end group plane. In the phase transition of aqueous monoglycerides induced by sucrose, $C \rightarrow H_{II}$, the increased wedge-shape is probably due to a reduction in the area of the polar groups at the interface between the sucrose solution and the hydrocarbon region. Sucrose is a hydrophilic molecule and is therefore assumed not to interfere with the hydrophobic part of the lipid.

Monoolein is one homologue of the technical monoglyceride mixture used in the ternary diagram reported above. To samples of monoolein, aqueous solutions of sucrose, trehalose, fructose and glucose were added. The results are summarized in Table 2. The binary system monoolein-water was in agreement with the same system investigated by Hyde et al. This Example shows that monoolein swelled in sugar solutions of both mono- and disaccharides has a different phase behavior than monoolein swelled in the same amount of water. Substitution of some water by sucrose is shown to have a greater effect on the phase properties of hydrated monoolein than when the same amount of water is replaced by fructose.

Water can dissolve 68.2% (w/w) of sucrose at 30°C (Charles) and sucrose crystallization only occurs in supersaturated solutions. In samples with both H_{II} phase

and aqueous sucrose solution, the sucrose will crystallize at lower sucrose concentrations, assuming that the added water and sugar form a homogeneous mixture. Relatively little has been reported on such interactions between aqueous carbohydrate solutions and liquid crystalline phases. Two alternatives, which both promote sugar crystallization, are mentioned in the literature. One is an asymmetrical distribution of sugar between the liquid crystalline phase and the solution (Koymova et al.), and the other is a type of surface association of sucrose molecules in the vicinity of the aggregated amphiphile molecules (Tyrell et al.). Both of these suggestions may have relevance for sucrose crystallization in the presence of monoglycerides.

Within the liquid crystalline phases, formed by water and monglycerides, the acyl chains are in a disordered state, while the hydrated polar groups are anchored by an ordered hydrogen bond system. The phase behavior of a monglyceride-sucrose-water system indicates that the sucrose alters the hydrogen bond system in such a way that the polar head groups become more close-packed laterally. For any change in physical properties, which is related to the amount of dissolved molecules, monosaccharides such as fructose are expected to be more effective than disaccharides such as sucrose on a weight basis. The results in this Example show that sucrose has a greater effect than fructose, concerning the phase properties of hydrated monooleins. This illustrates the interaction between sugars and hydrated monoglycerides is related to the structure of the carbohydrate.

Thus, the inventive delivery system is structurally different than systems employing polysaccharides. Further, this Example demonstrates that the sugar used in the present invention indeed stabilizes the alpha gel.

TABLE 1. Experimental low-angle X-ray diffraction data for the system monoglyceride-water-sucrose at 30°C (The phase were identified by X-ray diffraction, ratio of spacings, 1:3:4, and polarization microscopy).

Composition (%) (w/w)			a	Phase
Monoglyceride	Sucrose	Water		
75.2	16.1	8.7	47.5	$L2+H_{II}$
84.8	3.0	12.2	47.0	$L2+H_{II}$
79.4	4.1	16.5	51.6	H_{II}
70.2	19.4	10.4	47.7	H_{II}
80.1	7	12.4	46.2	H_{II}
79.9	2.0	18.0	51.2	H_{II}
75	2.5	22.5	49.2	H_{II}
76	1.7	22.1	45.0	H_{II}
54.9	29.3	15.8	47.7	H_{II}+liq.
49.9	32.6	17.5	46.2	H_{II}+liq.
40.3	38.8	20.9	46.3	H_{II}+liq.
65	12.3	22.8	52.7	H_{II}+liq.
50	17.5	32.5	51.8	H_{II}+liq.
59.9	20.1	20.1	51.4	H_{II}+liq.
51	25	24	50.8	H_{II}+liq.
40.2	29.9	29.9	54.4	H_{II}+liq.
74.6	12.7	12.7	45.3	H_{II}+liq.
69.7	6.1	24.2	58.1	H_{II}+liq.
65	7	28	51.4	H_{II}+liq.
59.9	8.0	32.1	57.2	H_{II}+liq.
44.9	11.2	43.9	59.1	H_{II}+liq.

a: hexagonal lattice parameter calculated from the diffraction lines.

TABLE 2. Phase behaviour of some monoolein (1-Monooleoyl-rac-Glycerol)-water-sugar samples at 25°C. The different phases were detected by polarization microscopy.

Type of sugar	Composition (w/w), %			Phases
	Monoolein	Sugar	Water	
Sucrose	81.9	0.9	17.2	C
Sucrose	80.4	8.6	11	H_{II}
Fructose	79.7	8.6	11.7	C
Trehalose	87.4	2.9	9.8	C
Glucose	83.1	3.1	13.8	C

Additionally, this Example demonstrates that in the foregoing text, amounts specified for the emulsifier, sugar and water in the inventive delivery system are preferred amounts, and that these amounts can be varied to still obtain a stabilized alpha gel of the invention. For instance, Table 1 shows that the amount of emulsifier can be as high as about 80 % (w/w) and in the range of about 40 to 80 % (w/w), the amount of the sugar can be from about 4 % (w/w) to about 40 % (w/w), and the amount of water can be in the range of about 10 to about 44 % (w/w). Thus, from this Example the skilled artisan can obtain additional embodiments of the invention, e.g., with respect to amounts of emulsifier, sugar and water for particular formulations.

EXAMPLE 2

AN INVENTIVE DELIVERY SYSTEM

An integrated emulsifier blend consisting of 65 parts polyglycerol esters of fatty acids (GRINDSTED™PGE 55 KOSHER mfg. by DANISCO INGREDIENTS), 25 parts distilled monoglyceride (DIMODAN® O KOSHER mfg. by DANISCO

INGREDIENTS) and 10 parts sodium stearoyl lactylate (EMPLEX mfg. by American Ingredients) at a temperature of 65°C was dispersed into a high fructose corn syrup (Isosweet 180 mfg. by A.E.Staley) with intense agitation at a loading of 30% on a total weight basis. The dispersion was then cooled to 42°C under continued agitation and then allowed to temper at ambient temperature for 2 days.

EXAMPLE 3

ANOTHER INVENTIVE DELIVERY SYSTEM AND USES THEREOF

An integrated emulsifier blend consisting of 65 parts distilled monoglyceride (DIMODAN® O KOSHER mfg. by DANISCO INGREDIENTS), 25 parts polysorbate 60 (TWEEN 60 mfg. by ICI) and 10 parts sodium stearoyl lactylate (EMPLEX mfg. by American Ingredients) at a temperature of 65°C was dispersed into a high fructose corn syrup (Isosweet 180 mfg. by A.E. Staley) with intense agitation at a loading of 35% on a total weight basis. The dispersion was then cooled to 40°C under continued agitation and then allowed to temper at ambient temperature for 2 days.

Prepared mixes/cakes formulation:

Prepared bakery mixes for cakes, muffins, brownies and the like represents a very large segment of the baking industry and serves a very important role for homes, store bakeries, institutional kitchens and restaurants. A large variety and forms of such mixes are manufactured to provide high eating quality and convenience for the end consumer. Although there are many types, the standard yellow layer cake is one of the most common. The basis ingredients of a prepackaged mix for yellow cake is as follows:

Ingredients	weight %, total mix basis
granulated sugar	39.9
cake flour	33.5
non-fat dry milk	3.1

salt	0.9
modified starch	1.5
baking powder	2.3
powdered egg whites	8.8
emulsified cake shortening	10.0
TOTAL	**100.0**

These basic ingredients can be augmented with various optional ingredients such as flavoring spices, nuts, etc. In addition, the level and ratio of the ingredients can vary somewhat depending on the application of the mix. As an example, if the mix is designed for a layer cake as opposed to a loaf pan, the ratio of sugar to flour can be higher since a layer cake requires less structural strength than a loaf cake. Also the ratios of the sugar to flour can be increased if a higher absorption cake is desired.

The type of the emulsifiers that are applied to these mixes can vary but typically are a combination of mono- and diglyceride with either propylene glycol esters of fatty acids or polysorbate 60. In addition, emulsifiers such as lecithin, polyglycerol esters of fatty acids, sorbitan esters of fatty acids, ethoxylated monoglycerides may be incorporated as a replacement for or as an addition to the before mentioned. The shortening system provides a variety of functions during the preparation of the cake and for the eating quality of the finished product including:

- lubrication for the batter;
- adding structure to the batter;
- enhancing air incorporation to the batter; and
- shortening the texture in the baked product.

In addition, the shortening serves to deliver the emulsifiers to the mix. The shortening is generally based on a blend of partially hydrogenated soybean oil with either fully hydrogenated cottonseed oil or fully hydrogenated palm oil. To insure that the resulting mix will be free flowing and to reduce lumping, the shortening system selected must

provide a level of solids for a sufficient degree of crystallization on the dry solids. Depending on the solid fat content and/or level of the emulsifiers in the shortening, the loading can vary from 5 - 15%. In most cases this loading represents only a fraction of the total fat content in the finished cake as the consumer will add additional plastic shortening or liquid oil during preparation.

Generally, preparation of the mix involves first weighing the ingredients individually and then transferring all to a high efficiency blender. The shortening system would then be added to the mixer and creamed or plated onto the dry blend. If necessary, the mix may be passed through several sieves and additional mixers to insure a uniform and free flowing blend before packaging.

Application of the invention, e.g., either of the formulations of this Example or of Example 2 allows the delivery of the emulsifiers into the mix without a shortening as the processor would plate the dry ingredients with the invention. As a result, all of the fat in the finished cake would be incorporated during the processing of the mix. This invention thus provides very effective emulsifying and aerating capabilities for the batter. It can also offer other advantages such as:

- The removal of less nutritious hydrogenated fats which contain low ratios of polyunsaturated fatty acids to saturated fatty acids. In addition, these partially hydrogenated fats contain high levels of positional and geometrically isomers. The consumer could simply add a salad oil found commonly in the home such as soybean, corn, canola, or sunflower oil instead of the fat of the shortening.
- Reduction in the production cost of the mix.

As an example of the invention's effectiveness, the following formulation provided a yellow layer cake:

YELLOW CAKE FORMULATION

Ingredients	grams
stage 1:	
granulated sugar	120.0
cake flour	100.0
non fat dry milk	8.8
salt	2.7
modified starch	4.4
baking powder	6.5
powdered egg whites	25.0
stage 2:	
emulsifier dispersion (from Example 2)	15.5
stage 3:	
water	120.0
whole eggs	60.0
liquid vegetable oil	50.0

Processing:

(1) The ingredients from stage 1 were weighed and dry blended in a Hobart bowl.

(2) The emulsifier dispersion was weighed and then applied by creaming onto the dry blend. Mixing or sieving was continued until the dispersion was uniformly applied to the entire surface of the dry mix ingredients.

(3) With continued mixing in the Hobart bowl, the eggs and water listed in stage 3 were added. After the addition was complete, the mixing speed was raised to 2 for 2

minutes. Finally, oil was added with additional mixing of 2 minutes.

(4) The batter was placed into a greased pan and baked at 350°F for 15 minutes.

(5) The cakes were then removed from the pan and placed on a rack to cool for 1 hour before evaluating.

Results:

The cakes prepared with the inventive emulsifier dispersion had excellent volume and a tight crumb structure. In addition the cakes had excellent uniformity in dimensions and crown coloration. The surface of the crown was free from any significant defects such as blistering or bubbles. The crumb was quite soft with excellent mouthfeel.

Snack cakes:

A snack cake may be defined as a wrapped unit of soft cake weighing between 1 to 3 ounces, usually filled and topped with an icing or compound coating. Production and consumption of this type of cake have rapidly grown because of numerous advantages for the producer and the consumer. For the consumer, these snack cakes represent a convenient food for eating between meals or to be included with meals (e.g., sack lunches, picnics, etc.). For the producer, these cakes which are designed for a single serving are smaller and thus maintain greater structural stability during baking.

Preparing cakes with liquid oil on an industrial level is generally more demanding since liquid oil can depress the foam production from the egg proteins whereas plastic shortening seems to support foam.

A typical formulation for a snack-type cake is as follows:

INGREDIENTS	% (flour basis)
stage 1:	
Flour, cake	100.00
Sugar, granular	59.00
Dextrose	23.00
Nonfat dry milk	2.00
Dairy blend	4.30
Soy flour	8.00
Yellow coloring	2.00
Vanilla Flavoring	1.00
Salt	2.50
Baking powder	5.00
stage 2:	
Whole eggs	13.00
Water	55.20
Corn syrup	33.00
stage 3:	
Emulsified shortening	11.50
stage 4:	
Water	36.00

Again, as in the Yellow Cake Formulation according to this invention, an inventive emulsifier system can be employed as a replacement or as a compliment for the emulsified shortening. In the case of this invention being applied as a replacement for the emulsified shortening, an all purpose or non-emulsified shortening may be

employed instead of the emulsified shortening. As such, the following snack cake was prepared:

INGREDIENTS	% (flour basis)
stage 1:	
Flour, cake	100.00
Sugar, granular	59.00
Dextrose	23.00
Nonfat dry milk	2.00
Dairy blend	4.30
Soy flour	8.00
Yellow coloring	2.00
Vanilla Flavoring	1.00
Salt	2.50
Baking powder	5.00
stage 2:	
Emulsifier dispersion (from Example 3)	2.70
Whole eggs	13.00
Water	55.20
Corn syrup	33.00
stage 3:	
All purpose shortening	11.50
stage 4:	
Water	36.00

PROCESSING:

(1) The stage 1 ingredients were dry blended for 2 minutes on low speed.

(2) The emulsifier dispersion (from Example 3) was added and blended on low speed for 2 minutes. The remaining stage 2 ingredients (eggs, water, corn syrup) were added with mixing continued until smooth; 1 minute on low and 2 minutes on medium speed.

(3) The stage 3 ingredients were added and mixed for 1 minute on low speed.

(4) The mixing was continued for 2 minutes on medium speed until lumps disappear. The bowl was scraped.

(5) The stage 4 ingredients were added and mixed in for 1 minute on low speed and 3 minutes on medium or until smooth and desired specific gravity was achieved (batter temperature app. 76-78°F)

(6) The batter was scaled into greased cups and baked at 375°F for 11 minutes.

(7) The cakes were allowed to cool for 1 hour before evaluating.

Results:

The batter ingredients wetted and aerated very quickly. The finished snack cakes were characterized as having a very tight, soft grain in the crumb with a uniform crown. Overall the cakes had excellent eating quality.

This Example demonstrates that the invention comprehends finished foodstuff, and that the invention is useful in the preparation of foodstuff.

EXAMPLE 4

ANOTHER INVENTIVE DELIVERY SYSTEM AND USES THEREOF

Caramels

The following ingredients were added to an ordinary pot and were mixed while being

heated on a hot plate.:

318.6 g glucose syrup 42 DE

220.0 g sugar

15.4 g emulsifier delivery system*

250.0 g condensed milk

80.0 g water

* The emulsifier delivery system contained 26% mono-diglycerides (GRINDSTED™ TOFFAN 60) and 74% glucose syrup 42DE.

After mixing of the above ingredients, 110.0 g fat (hydrogenated palm kernel oil), and 5.0 g salt were mixed by agitation while being heated to 127°C. To adjust the consistency, the water content was adjusted to the desired level by weighing before and after heating to 127°C.

The caramel was cooled to a temperature below 60°C and the caramel flavour was added. After addition of flavour, the caramel was cut into small pieces.

The use of the emulsifier delivery system provided caramel having stickiness, cutting, and improved shelf life properties comparable to that of caramel prepared by the addition of emulsifier by itself.

The emulsifier delivery system in accordance with the present invention can be modified by replacing the mono-diglycerides (GRINDSTED™ TOFFAN 60) with distilled monoglycerides (DIMODAN® PM).

EXAMPLE 5

ANOTHER INVENTIVE DELIVERY SYSTEM AND USES THEREOF

Halawa

The following ingredients were mixed in a pot:

347.0 g sugar

141.76 g glucose syrup

19.24 g emulsifier delivery system*

0.7 g citric acid

80.0 g water

* The emulsifier delivery system contained 26% sorbitan monostearates (GRINDSTED™ SMS) and 74% glucose syrup 42DE.

After mixing, the sugar solution was heated on a ordinary hot plate to 128°C while being stirred continuously. The boiled sugar mass was filled into a Hobart mixer connected to a 100°C hot oil bath and whipped for 4 minutes with the flat whisk at speed 2. 485.0 g tahina was heated in a water bath to 40°C and 10.0 g distilled monoglycerides (DIMODAN® PV) were added to the 40°C warm tahina and mixed well to prevent oil separation. The whipped sugar mass and tahina were then mixed manually. First, it was folded gently with a rubber spatula and then the layers of tahina and sugar mass were folded by hand over and over again with a pulling movement. Finally, the halawa was filled into a tin.

The emulsifier delivery sytem acted as a delivery system for sorbitan monostearates (GRINDSTED™ SMS). This emulsifier functions as a whipping agent in the sugar mass, providing halawa having good colour and texture.

EXAMPLE 6

ANOTHER INVENTIVE DELIVERY SYSTEM AND USES THEREOF

Ice Cream and Dairy Products

The structure of aerated emulsions such as ice cream, and other aerated desserts such as mousse, whipped dairy, and vegetable cream consists of air cells distributed uniformly in a frozen or liquid continuous phase containing carbohydrates, proteins, and fat globules. The texture and stability of the whipped product is related to the air cell structure which is built up by shells of fat globules or crystals arranged at the interface between air and water.

The driving force for this structure to be built is a partial destabilisation of the fat globules during the whipping process.

The destabilisation involves both a desorption of protein from the fat globule surface and a crystallisation of the fat phase taking place e.g. during the aging period of an ice cream mix before freezing.

Both these processes are essential for the whippability of emulsions and are enhanced by emulsifiers such as monoglycerides and lactic acid esters of mono- and diglycerides.

The following recipes were prepared

	Recipes		
Ice cream	Reference	1	2
Composition	%	%	%
Dairy cream, 38% fat	23.65	23.65	23.65
Skimmed milk	53.50	53.39	53.44
Skimmed milk powder	4.90	4.90	4.90

Sugar	7.60	7.60	7.60
HFCS	4.40	3.95	3.95
Glycose syrup, DE 42, 75% TS	5.35	5.35	5.35
Hydrocolloid blend	0.18	0.18	0.18
Flavour	0.05	0.05	-
CREMODAN® SUPER	0.37	-	-
Delivery Systems			
40% CREMODAN® SUPER, 60% HFCS*	-	0.93	-
40% CREMODAN® SUPER, 5% Flavour, 55% HFCS	-	-	0.93
Total	**100.00**	**100.00**	**100.00**

* High Fructose Corn Syrup (HFCS)

The recipes were prepared in accordance with the following process

1. Pre-heat milk to 40°C
2. Add all ingredients.
3. Mix continuously until all ingredients are fully dissolved
4. Pasteurise at 80°C/20 sec.
5. Homogenise at 80°C/190bar.
6. Cool to 1-3°C
7. Age overnight
8. Freeze in continuous freezer to 100% overrun
9. Harden in tunnel at -40°C
10. Store below -25°C

Dairy whipping cream

	Reference	
Composition	%	%
Dairy cream, 38% fat	79.00	79.00
Skimmed milk	13.99	13.99
Sugar	6.00	6.00
GRINDSTED™ Carregeenan CL 110	0.012	0.012
HFCS	0.60	0.00
GRINDSTED™ LACTEM P22	0.40	0.00
40% GRINDSTED™ LACTEM P22, 60% HFCS	0.00	1.00
Total	**100.00**	**100.00**

Process:

1. Pre-heat milk to 40° C
2. Add all ingredients to cold liquids
3. Mix continuously until all ingredients are fully dissolved
4. UHT-treat at 142°C/3 sec.
5. Homogenise at 80°C/30bar
6. Cool to 5°C
7. Store at 5°C

The above recipe in accordance with the present invention was comparable in appearance, texture and flavour with the reference product.

The above recipe clearly showed that the delivery system of the present invention may be used to obtain results as good as the application of an ordinary emulsifier or an emulsifier stabiliser blend. Furthermore, the applicant found that the incorporation of the flavour via the delivery system worked as well as an ordinary applied flavour.

EXAMPLE 7

ANOTHER INVENTIVE DELIVERY SYSTEM AND USES THEREOF

Wetting Agents

As discussed above, many powders need to be readily dispersible in liquids such as water or milk. In the food industry this is the case in, for example, powdered isotonic sport drinks, instant cocoa powder and protein powders such as Na-caseinates.

Typically, powders can be rendered dispersible by an agglomeration process or by coating them with a surface active agent. For example, instant cocoa powders are very often coated with high amounts of lecithin (approx. 5% of an ordinary lecithin containing approx. 50% soy bean oil) to render the dispersible. However, this coating may cause off flavour problems due to the oxidation of the soy bean oil (often referred to as the reversion flavour typically for soy bean oil). Moreover, most of the lecithin used worldwide are derived from soy beans. Many supplies of soy beans comprise beans from genetically modified plants. Consumer pressure and legislation renders the use of such beans undesirable or unacceptable. Thus, there is a desire in industries such as the cocoa industry to replace lecithin with other emulsifiers.

The following experiments were performed using the following powders

1. Untreated defatted (10-12% fat) cocoa powder - Reference sample
2. Defatted cocoa powder coated with an ordinary lecithin (~ 50% oil). This powder was coated in the manner described below - Reference sample

Sample	Powder	Delivery system[a]	Delivery system conc. on cocoa powder
1	1	DIMODAN LS + PANODAN™ AB 100[b]	3.84%
2	1	None	
3	2	Lecithin	

a: The delivery system is 26% emulsifier and 74% high fructose corn syrup

b: DIMODAN LS and PANODAN™ AB 100 were added in a ratio of 3:1

c: The delivery system is 2.6% emulsifier and 97.4% high fructose corn syrup

Coating procedure

The cocoa powder was placed in a food processor/blender. The motor was started at maximum speed. The emulsifier/delivery system was added to the blender/food processor and mixed onto the cocoa powder for at least 3 min. The delivery system may be added either at room temperature or heated carefully until melted.

Test procedure

Wettability: 1 g of cocoa powder was mixed with 3 g of finely powdered sugar. The mixture was sieved onto a surface (either water or milk) and the time for the last cocoa powder to disappear underneath the surface is measured.

By the use of this invention it was possible to decrease the wetting time up to 50-75% as compared to the untreated reference sample of defatted coca powder. The coated and defatted cocoa powder in accordance with the present invention exhibited proper wetting properties and dispersability i.e. it sank faster than the untreated reference

sample.

EXAMPLE 8

ANOTHER INVENTIVE DELIVERY SYSTEM AND USES THEREOF

Fat Based Products

It was found that the delivery system in the production of margarine and fat based products allows for the simplification of the production process of fat containing products, particularly cake and cream margarine, fillings, chocolate spreads and low fat spreads. That is possible due to incorporation of the most important ingredients (advantageously emulsifier(s), stabiliser system, sugars and flavourings) in the delivery system.

The fat based products below were prepared in accordance with the following procedure:

1. Heat the water and blend the water phase ingredients, (pasteurise if necessary). Adjust pH. Temper to approx. 50-60°C.
2. Melt and blend the fat phase. Add the β-carotene and flavourings, if necessary.
3. Make the emulsion at 50-60°C, while agitating vigorously. Add the emulsifier delivery system.
4. Crystallise and knead in a tube chiller. Outlet temperature is 10-14 °C.

8.1 Cake margarine /cream margarine (full-fat and 60% fat)

		Full-fat	60% fat
Water phase	Water	16.0%	38.4%
	Salt	1.5%	1.5%
	K-sorbate	0.1%	0.1%
	GRINDSTED™ Alginate LFS 200*		1.0%

	pH 5.5		
Fat phase	Fat blend	80.9%	55.0%
	35 parts soya 41 °C		
	20 parts soya 35 °C		
	20 parts soya oil		
	25 parts coconut oil		
Emulsifier delivery system (in emulsion tank)		3.3%	5.0%

* Is added when there is no GRINDSTED™ Alginate LFS 200 in the Emulsifier Delivery System.

Emulsifier delivery system

	for full-fat		for 60% fat	
GRINDSTED™ PGE 20 VEG Polyglycerol Ester	30.0%	-	30.0%	-
ISOSWEET**	70.0%	-	70.0%	-
DIMODAN® PVP Distilled Monoglyceride	-	10.0%	-	10.0%
GRINDSTED™ PGE 55 Polyglycerol Ester	-	20.0%	-	50.0%
ISOSWEET**	-	70.0%	-	20.0%
GRINDSTED™ Alginate LFS 200	-	-	-	20.0%

** a High Fructose Corn Syrup

Results

The emulsifier delivery system for the addition of the emulsifier and stabiliser system in cake/ cream margarine resulted in stable products with good whipping and baking properties. The baked pound cakes had excellent uniformity and coloration. The top of

the cakes was free from any significant defects. The crumbs were quite soft with excellent mouthfeel.

8.2 Filling

Filling was made in a ice cream freezer with mono-pump (capacity 27 kg/hr). Nitrogen blown in after the pump and before the cooling cylinder. Outlet temperature: 15-17 °C.

Water phase	Water	12.5%
	GRINDSTED™ Pectin LFS 100	0.5%
	SMP	8.0%
	Sucrose	9.9%
	Invert sugar	9.0%
	Sorbitol 70%	8.0%
	Glucose syrup	14.0%
	Glycerol	7.0%
	K-sorbat	0.1%
Fat phase	Lecithin	0.4%
	Fat blend (100% coconut 31 °C)	26.6%
	Butter flavouring 2598	0.03%
Emulsifier delivery system (in emulsion tank)		4.0%

Emulsifier delivery system

DIMODAN® PVP Distilled Monoglyceride	25.0%
70% Glucose syrup	65.0%
Water	10%

Results

The filling cream was smooth with good flavour release. Specific gravity of the cream:

0.71 g/ml.

8.3 Snack cakes cream filling

High fructose corn syrup	49.7%
Powdered sugar	19.0%
Shortening	21.5%
Salt	1.0%
Sorbic acid	0.2%
Water	5.0%
HPMC K-100	0.1%
Na-caseinate	0.5%
GRINDSTED™ LACTEM P 22 Lactic Acid Ester	1.0%
PANODAN™ 150 DATEM	0.1%
GA 1738*	2.8%

* Emulsifier delivery system GA 1738 is 26% monoglyceride with high fructose corn syrup.

Results

The snack cakes cream filling was smooth with good flavour release. Specific gravity of the cream filling: 0.66 g/ml

8.4 Chocolate spread

Water phase	Water	25.0%
	Cocoa powder	5.0%
	SMP	3.0%
	Hazelnut paste	1.0%

	Salt	0.2%
	GRINDSTED™ Alginate LFS 200	0.7%
	Sugar	23.8%
	Potassium sorbate	0.1%
	pH 5.0-5.5	
Fat phase	Fat blend:	39.1%
	2 parts GRINDSTED™ PS 101	
	18 parts soya 41	
	30 parts soya 35	
	10 parts coconut oil	
	40 parts liquid oils	
Emulsifier delivery system (in emulsion tank)		2.1%

Emulsifier delivery system:

DIMODAN® CP Distilled Monoglyceride	24.1%
GRINDSTED™ PGPR 90 Polyglycerol Polyricinoleate	4.8%
Glucose Syrup	67.3%
Chocolate Flavouring 3031	1.9%
Hazelnut Flavouring 3433	1.9%

Results

The finished chocolate spread was characterised as a nice, stable product with fine mouthfeel and good flavour release with hazelnut note.

8.5 Low fat spread & 8.6 very low fat spread

The delivery system of the present invention was also is useful in the production of a low fat spread with and without protein (in accordance with example 8.5 given below)

and a very low fat spread (in accordance with formulations 8.6 given below). The delivery system was used for the delivery of flavourings and/or stabilising systems.

The spreads were prepared in accordance with the method given above.

8.5 - 40% Fat Spread with and without Protein

		With protein	Protein free
Water phase	Water	42.3%	57.2%
	Salt	1.2%	1.2%
	K-sorbate	0.1%	0.1%
	Whey powder	1.0%	-
	GRINDSTED™ Pectin LFS 100	1.0%	-
	pH 5.5		
Fat phase	Fat blend	39.5%	39.5%
	25 parts soya 41°		
	75 parts liquid oil		
Emulsifier delivery system (in emulsion tank)		1.7%	2.0%

Emulsifier delivery system for spread with protein

DIMODAN® OT Distilled Monoglyceride	29.2%
β-carotene	1.2%
Butter Flavouring 2873	0.6%
Butter Flavouring 3507	0.6%
ISOSWEET	68.4%

Emulsifier delivery system for spread without protein

DIMODAN® CP Distilled Monoglyceride	24.5%
β-carotene	1.0%
Butter Flavouring 3385	0.5%
Butter Flavouring 2807	0.5%
GRINDSTED™ Pectin LFS 100	24.5%
ISOSWEET	48.0%

8.6 - 20% Fat Spread with and without protein

		Protein-free	With Protein
Water phase	Water	73.0%	74.0%
	Salt	1.0%	1.0%
	Whey powder	-	1%
	K-sorbate	0.1%	0.1%
	pH 5.5		
	GRINDSTED™ LFS 560	2.0%	
	Stabilising System		
Fat phase	Fat blend	19.2%	19.2%
	75 parts soya oil		
	25 parts soya 41°C		
	GRINDOX™ TOCO 50	0.01%	0.01%
	Antioxidant		
Emulsifier delivery system (in emulsion tank)		4.7%	4.7%

Emulsifier delivery system

DIMODAN® LS Distilled Monoglyceride	21.2%
GRINDSTED™ PGPR 90	8.5%
ISOSWEET	69.3%

β-carotene	0.4%
Butter Flavouring 3195	0.4%
Butter Flavouring 3399	0.2%

Results of 8.5 and 8.6

The low-fat spreads and very low-fat spreads containing the new delivery system were stable and had good water dispersion. Sensory evaluation of the samples showed that they had a very good flavour release and colour.

EXAMPLE 9

ANOTHER INVENTIVE DELIVERY SYSTEM AND USES THEREOF

Fine Foods

The following recipes were prepared and tested:

30% Béchamel Sauce, with a pH of 5.5
30% Dressing with a pH of 4.0
50% Mayonnaise with a pH of 4.0

Béchamel Sauce Composition	%	Dressing Composition	%	Mayonnaise Composition	%
Veg. Oil	30.0	Veg. Oil	30.0	Veg. Oil	50.0
Bouillon	2.0	Sugar	1.0	Sugar	1.0
Wheat flour	1.0	Salt	1.0	Salt	0.3
K-benzoate	0.1	K-benzoate	0.1	K-benzoate	0.1
Modified Starch	2.0	Vinegar 10%	4.0	Vinegar 10%	4.0
Salt	0.3	Modified Starch	1.0	Modified Starch	1.0
GRINDSTED™ FF 5101 Stabiliser System	0.2	GRINDSTED™ FF 5101 Stab.	0.3	GRINDSTED™ FF 5101 stab.	0.2
					--
Emulsifier	A)	Emulsifier	B)	Emulsifier	B)

Water up to 100%		Water up to 100%		Water up to 100%	
Total	100.0	Total	100.0	Total	100.0

Dispersed Emulsifier and reference emulsifiers which has been tested

Emulsifiers	Dosage of sugar dispersion or emulsifier in the recipes	
	A)	B)
40% PANODAN™ AB 100 DATEM, 60% HFCS	1.10 %	1.25%
26% GRINDSTED™ CITREM N12, 74% HFCS	1.55 %	0.00%
PANODAN™ AB 100	0.44 %	0.50%
GRINDSTED™ CITREM N12	0.40 %	0.00%

The samples were made on a Koruma mixer (Colloid mill)

Process:

1. Mix water, and all dry ingredients except Emulsifier & Stabiliser system
2. Blend the sugar dispersed Emulsifier & Stabiliser system with part of the oil and add it to the water phase
3. Mix continuously until all ingredients have been fully dissolved
4. Emulsify the rest of the oil into the water phase
5. ***Alternatively***
   a) Pack
   b) Homogenise at 150 bar and pack
   c) Heat to 50°C for 1 minute before step 4) and pack
   d) Heat to 50°C for 1 minute before step 4) and homogenise at 150 bar and pack

Results - Béchamel Sauce:

Particle size measurement together with visual evaluation in microscope was used as a indication of the stability of the emulsion.

Mean diameter D[4,3] (μ m)	a) cold	b) Cold + 150 bar	c) Hot	d) Hot + 150 bar
PANODAN™ AB 100	17	7	23	6
Delivery system containing PANODAN™ AB 100	17	4	18	5
GRINDSTED™ CITREM N 12	40	28	90	32
Delivery system containing GRINDSTED™ CITREM N12	33	7	50	19

When looking at the performance of PANODAN™ AB100, one can see a slight improvement by adding the vegtable emulsifier through the present delivery system. The mean particle size diameter goes from 7 μm to 4 μm. The performance of GRINDSTED™ CITREM N12 is considerably improved, from the mean particle size diameter of 28 μm to 7 μm.

Results - 30% dressing and 50% mayonnaise:

pH 4.0, cold process and homogenisation at 150 bar

Emulsifier	Dosage %	Fat %	D[4.3] μm *
PANODAN™ AB 100	0.50	30	29
40 % PANODAN™ AB 100	1.25	30	8
PANODAN™ AB 100	0.50	50	70
40 % PANODAN™ AB 100	1.25	50	19

*(Mastersizer - Particle diameter measurements)

It was not possible, in a cold process, to make a stable emulsion with the recipe with a ordinary applied emulsifier. In contrast using the dispersed emulsifier in accordance with the present invention, the emulsion was stable. The differences between the two

emulsion was even greater at higher fat level. The 50% mayonnaise made with ordinary applied emulsifier was unstable and transparent, whereas the dispersed emulsifier was stable with a white appearance.

Conclusion:

The experiment clearly showed that the emulsifier delivery system of the present invention worked better than an ordinary applied emulsifier. To obtain sufficient emulsifying power with the ordinary applied emulsifier it is necessary to homogenise before packing.

In contrast to normal behaviour of CITREM emulsifier, the present delivery system used in a cold process made a stable emulsion (D < 20 μ m). Thus, with the system of the present invention not only is it possible to use a vegetable emulsifier as a dispersed emulsifier in a cold system, but the stability of the emulsion is improved.

The system of the present invention may also be used in the preparation of:

- Mayonnaise and similar products (low-fat, fat-free etc.)
- Dressings and dips
- Emulsified sauces
- Cream-based sauces
- Emulsified soups
- Cream based soups
- Spice emulsions

The delivery system of the present invention may also be used in the following processes and equipment:

- Stephan Cooker (or similar)
- Schröder Combinator (or similar)

- Fryma Mixer
- Herbort Mixer
- Other high shear mixers

EXAMPLE 10

ANOTHER INVENTIVE DELIVERY SYSTEM AND USES THEREOF

Flavourings

In the production of low-fat spread it is often necessary to use two flavourings: one for the oil phase and one for the water phase.

An emulsifier delivery system in accordance with the present invention may be prepared to deliver two such flavourings. The delivery system consists of emulsifier, sugar and flavourings. The delivery system should be added to the emulsion, while agitating continuously.

Example

A delivery system having the following recipe was incorporated in a 40% fat spread in accordance with example 8.5.

Delivery system

Butter Flavouring 3385	5.0%
Butter Flavouring 2807	5.0%
DIMODAN® CP Distilled Monoglyceride	20.0%
ISOSWEET	70.0%

Concentration of the delivery system in the low-fat spread was 0.2%.

Results

Evaluation of the test sample and the control sample to which the flavourings were added via the fat and oil phases showed that both samples had a creamy, fresh and fermented taste, and that there was no difference between them.

The present invention is advantageous because the two flavourings may be added in a simple manner as a single system, integrated with the emulsifier(s).

EXAMPLE 11

ANOTHER INVENTIVE DELIVERY SYSTEM AND USES THEREOF

Baked Goods

The delivery system of the present invention can successfully be used as a delivery system for functional ingredients for baked goods, such as cakes, sweet dough system, laminated doughs, biscuits and liquid batters.

The delivery system of the present invention is advantageous for the preparation of bakery and cereal products (such as like sponge cakes, Swiss rolls, tea buns, hamburger buns, crackers, biscuits, and wafers) because:

- the emulsifier is kept stable in its active form
- it is possible to integrate different functional ingredients such as emulsifiers, enzymes, flavours, hydrocolloids, starch, salts, proteins
- a pumpable delivery system is provided, as an alternative to bakery functional ingredients which can be a mixture of powdered, beads, flakes, or liquid ingredients.
- an integrated product may be prepared containing emulsifier in combination with different types of further deliverable substances, for example different types of emulsifiers (saturated with unsaturated), different types of food grade enzymes, different types of flavourings (oil as well as water soluble) and/or hydrocolloids.

- functional ingredients are easier distributed in the system.

The following baked goods were prepared

11.1 Low fat and No fat Cakes

Sponge cakes and low to no fat cakes are produced from egg, sugar, flour, baking powder and eventually some fat e.g. butter, margarine and/or oil. In small scale production e.g. household, egg and sugar are whipped together in order to provide an aerated and light cake, afterwards, flour, baking powder, a little water is added. This is however a time consuming process as the preparation of the cake batter include several mixing steps. In industrial scale it is much more convenient if all the ingredients are added in a 'all in one' process meaning that all ingredients are added and mixed together, this process however does not give sufficiently aeration to the cake batter and the result will be a very flat and dense cake. Emulsifiers like mono-di glycerides, lactic acid esters of monoglycerides, polyglycerol esters, polyglycerol monostearate, sorbitan monostearate, can when they are dispersed in water or on an active alpha form provide both aeration and batter stability.

11.2 Sponge cakes

A sponge cake is typically prepared as an all in one procedure where all the ingredients are added at the same time and immediately whipped. Emulsifiers must be added to the mixture of ingredients. Preparing a cake as an all in one procedure without using emulsifiers results in a collapse of the cake as the air incorporation is not stabilised. The use of emulsifiers is essential in preparation of these cakes in an "all in one" procedure.

When emulsifiers are used they can be added in different ways: hydrated as in a gel, spray crystallised, or spray dried on a powdered carrier system, however the main thing is that the emulsifier is in an active α-form when used.

The following recipes were prepared wherein the emulsifier is either added as a powdered sponge improver or as a gel.

Ingredients	A) with powdered improver	B) with GRINDSTED ™ GA 505 gel	C) with GRINDSTED ™ GA 504 gel	D) with present delivery sys.
Sugar 35/20	208	200	200	190
Flour	188	160	160	160
Corn Starch	60	75	75	75
Baking powder	14	4	4	4
Egg	200	235	235	235
Water	150	100	100	100
Delivery system *	0	0	0	20
Powdered sponge cake improver	30	0	0	0
GRINDSTED™ GA 505 Gel	0	18	0	0
GRINDSTED™ GA 504 Gel	0	0	18	0

* a delivery system in accordance with Example 2

Procedure:

A: Mix all the ingredients for 6 min. on a Hobart N50.
Scale 2 x 350 g into round sponge cake tins.
Bake for 35 min. at 180°C.
If softness measurements are required:
scale 350 g into a round sponge cake tin and 3 x 175 into softness tins.

B,C&D: Mix all the ingredients for 3 min. on a Hobart N50 at 3rd speed.
Scale 2 x 350 g into round sponge cake tins.
Bake for 35 min. at 180°C.

By the use of the present delivery system it is possible to produce low fat cakes as an all in one procedure with similar properties regarding surface smooth and even, volume. The crumb structure is however finer and the reliance is improved - sensorically tested the cake is much more moist even after 14 days and thus the performance of this delivery system compared to a powdered sponge cake improver or an emulsifier - in a gel system is improved.

Baking trials were performed. The results are as follows:

	A (powdered)	B (GA 505)	C (GA 504)	D (delivery sys.)
Litre weight	350	345	340	342
Specific volume	5.58	5.35	5.54	5.63

All cakes were homogeneous with good and even crumb structures. The cake prepared with the delivery system had improved bite and resilience and a slightly darker surface.

The above examples were repeated to prepare Swiss rolls of a similar recipe. Swiss rolls had similar properties to rolls made in accordance with typical prior art procedures.

11.3 Sweet dough systems

Sweet doughs are characterised by the presence of sugar in the recipe, eventually also fat and/or eggs. In sweet doughs emulsifiers, enzymes and flavourings are often used as functional ingredients. The delivery system of the present invention can be successfully be used as a delivery system of functional ingredients such as emulsifiers (e.g. DATEM,

CITREM, ethoxylated monoglycerides, polysorbate, monoglycerides, sodium stearoyl lactylate [SSL] and calcium stearoyl lactylate [CSL]) and enzymes found in a sweet dough or any other dough system. Commonly found enzymes include amylolytic enzymes and other enzymes capable of modifying starch, non-starch polysaccharides, protein or lipids and enzymes capable of oxidising or reducing components. Other functional ingredients often used in such doughs include flavourings (butter, citrus, panetone, bread) in for example tea buns, hamburger buns, brioche (French product), panetone (Italian product). The present delivery system can be used in both straight dough procedure, chorleywood procedure as well as the more labourious US sponge and dough type of bread.

The following recipes were prepared in accordance with the usual procedure of making a bread or a sweet dough bread or roll, namely mixing, ± resting, scaling, resting, moulding, shaping, proofing and baking.

Ingredients	Tea buns		Hamburger buns		Brioche	
Flour	1500	1500	1500	1500	1725	1725
Egg	0	0	0	0	450	450
Salt	15	15	30	30	15	15
Sugar	150	125	190	165	360	330
Compressed yeast	150	150	90	90	75	75
Fat	150	150	75	75	0	0
Butter	0	0	0	0	330	330
Gluten	0	0	45	45	0	0
Ascorbic acid	0	0	0	0	60	60
Water	870	870	900	900	450	450
Cystein	0	0	20ppm	20ppm	0	0
PANODAN™ DATEM	4.5	0	4.5	0	5.18	0
DIMODAN®	4.5	0	4.5	0	5.18	0

GRINDAMYL™ S 100	200ppm	0	200ppm	0	200ppm	0
Delivery system*	0	35	0	35	0	40

*The delivery system contains 12.5% PANODAN™AB 100, 12.5% DIMODAN® SDM-T, 1.0% GRINDAMYL™ S100, and 74% High Fructose Corn Syrup.

Procedures

Tea buns: mixing 2+10 min on a Hobart mixer with hook. dough temperature approx. 26°C. Scale 1350 g, moulding (Fortuna 3-17-7). Proofing 50 min at 35°C, 85% RH. Baking 10 min at 220°C.

Hamburger buns: mixing on a Hobart mixer 2+15 min. (Dough temp approx. 26°C). Scaling (1800 g). resting 5 min. Moulding (Fortuna 6-27-5). Rolling out 3.5mm. Proofing 50 min at 40°C, 85% RH. Baking 12 min at 195°C.

Brioche: Flour and sugar are dry blended, if functional ingredients (enzymes, emulsifiers, flavourings) are used they are also added at this step. Eggs, water and butter is added, mixing 3+5 min. Add yeast, mix for another 5 min (2nd speed), salt is added, mix for 10 min (2nd speed). Resting 30 min at 30°C, 80% RH. Scaling (400 g). proofing 150 min at 30°C, 80% RH. Baking approx. 30 min. at 180°C.

Baking trials in sweet dough systems e.g. tea buns, hamburger buns, or brioche comparing the effect of using single ingredients PANODAN™ AB 100, DIMODAN® SDM-T and GRINDAMYL™ S 100 and the delivery system of the present invention (containing a combination of PANODAN™ AB 100, DIMODAN® SDM-T and GRINDAMYL™ S 100) have proven that the use of the present delivery system provides desirable properties to the baked goods e.g. improved volume and tolerance, as the conventional systems. Better softness and a more homogenous crumb structure was

also provided by the present delivery system. Moreover, by using the present delivery system easier dosing was possible as only one and not three ingredients had to be scaled.

The results of trials performed in respect of tea buns in accordance with the above recipe are as follows:

	Standard recipe	Delivery system
Specific volumne	7.89	7.85
Comments	Capping in some of the rolls due to lack of stability	Good and homogenous rolls

No differences were observed regarding dough handling. The overall best appearance was seen in rolls prepared with the delivery system.

11.4 Laminated doughs

In laminated dough systems emulsifiers (e.g. PANODAN™ DATEM, polysorbate, CITREM, SSL, CSL) and enzymes are often used in order to improve the dough handling, ease the lamination process and improve the baking performance and texture of the final product. Baked products where laminations are commonly used are products like crackers, puffed biscuits (Japanese style), croissants and puff pastry.

The delivery system of the present invention provided an eased delivery system as well as an improved distribution of functional ingredients like emulsifiers, enzymes and flavourings.

The following recipes for crackers, croissants and biscuits were followed.

11.4.1 Crackers

Ingredient	Standard Amount (g)	with delivery system
Wheat flour	640	640
Shortening	120	120
Whey powder	12	12
Ammonium bicarbonate	10	10
Salt	8	8
Water	200	200
PANODAN™ AB 100	1.3	0
Delivery system *	0	3.25
Sodium metasulphite based on total recipe	400 ppm	400 ppm

* containing 40 % PANODAN™ AB 100 and 60 % HFCS

Procedure

1. Sodium meta-bisulphite (SMS) was added as a 2% solution. The addition is 12.8 g which corresponds to 400 ppm calculated on the total amount of dough.
2. All-in-one procedure.
3. Kneading time: Until a dough temperature of 35°C is reached. After mixing the dough rest for 10 min.
4. The dough is rolled down to 3 mm. and the dusting powder is placed on the center of the dough piece.

Dusting powder

Wheat flour	83.0 g
Shortening	18.0 g

Salt 0.6 g

1. Mixed as all-in-one procedure and kneaded for 15 min.
2. Laminating: 3 x 3 without turning. Roll down to 1.0 mm. After laminating the dough rests for 5 min.
3. Baking: 200 °C - 6 min. in Werner Pfleider (WP) oven.

Similar results were obtained by adding the emulsifier (PANODAN™ AB 100) using the present delivery system as if it were added as a single ingredient. An advantage of using the delivery system of the present invention is that when more than one functional ingredients is used, all the functional ingredients may be incorporated in the delivery system e.g. flavours, enzymes. Then only one product (the delivery system) has to be scaled instead of several minor ingredients.

11.4.2 French croissants

Ingredients	g	
Flour	1000	1000
Yeast	30	30
Salt	20	20
Sugar	100	95
Egg	60	60
Water	600	600
PANODAN™ AB 100	4	0
delivery system consisting of 40% PANODAN™ AB 100 and 60% HFCS	0	10
Puff pastry margarine	400	400

Procedure

1. Mixing on a Mahot mixer 4+2 min
2. Resting covered for 90 min. laminated 2x3 + 1x4
3. Proofing for 90 min at 25-27°C, 70% RH
4. Baking 15 min at 230°C.

The baking performance of the two different recipes performed identically. An advantage of using the delivery system of the present invention is that when more than one functional ingredients is used, all the functional ingredients may be incorporated in the delivery system e.g. flavours, enzymes. Then only one product (the delivery system) has to be scaled instead of several minor ingredients.

11.4.3 Biscuits

The production of biscuits starts with creaming up the fat and sugar. The flour is added as the last ingredient in the recipe and will be (if the recipe is close to balanced) covered by the fat. Emulsifiers such as PANODAN™ DATEM, SSL and/or lecithin may be added in such a system. Other emulsifiers (e.g. GRINDSTED™ CITREM and GRINDSTED™ LACTEM) which improve the dough handling, improve the fat distribution (specially if and fat reduced recipe is used) or the texture of the biscuits may also be used. Often biscuits like Lincoln or Marie (laminated) type also contain flavourings (which may be both oil and water soluble) e.g. butter, vanilla, cacao, red berries, citrus types. In order to prevent the gluten development enzymes e.g. proteolytic types can be used to degrade or reduce the protein structure.

The following recipe was followed to prepare rotary moulded or wire cut biscuits. In this manner a delivery system in accordance with the present invention containing emulsifier, enzymes and flavourings was successfully used in the production of biscuits.

Ingredients, g	Control	Present Invention

Flour	588	588
Fat	146	124
Caster sugar	173	167
Water	62	62
Skimmed milk powder (SMP)	10	10
Salt	6	6
$NaHCO_3$	2	2
NH_4HCO_3	1	1
PANODAN™ AB 100 DATEM	4	0
Delivery system *	0	10

* 40 % PANODAN™ AB 100, 60 % HFCS

Procedure

- Ammonium bicarbonate is dissolved in water to avoid black spots on the biscuits.
- All ingredients, except flour and water/NH_4HCO_3 is creamed up on a Hobart N50 for 1 min. at 1st speed. If a flavouring is to be added, it should be added at this stage.
- Water and NH_4HCO_3 are added next and mixed for 3 min. in 2nd speed.
- The flour is added and the batter is mixed for 7 min. at 1st speed.
- The biscuits are baked at 180°C for approx. 6 min. or program 9 in the Werner Pfleider oven.

Similar results were obtained by adding the emulsifier (PANODAN™ AB 100) through the inventive delivery system as if it were added as a single ingredient. During trials the consistency of the biscuit doughs and the appearance of the biscuits were comparable between two recipes. An advantage of using the delivery system of the present invention is that when more than one functional ingredients is used, all the functional ingredients may be incorporated in the delivery system e.g. flavours, enzymes. Then only one product (the delivery system) has to be scaled instead of several minor

ingredients.

11.5 Liquid dough systems

Wafers and waffles

For baked products like wafers and waffles where flowability of the batter is an important issue, like a cold hydrophilic system like a wafer batter, with a slow mixing and where gluten development is not desired, a homogenous distribution of emulsifier can be difficult to obtain. By the use of the delivery system of the present invention as an emulsifier delivery system the homogenous distribution of emulsifier in the batter is facilitated/eased, and the temperature for the wafer batter can be decreased.

Recipe:

Ingredient	g	
Wheat flour	374.0	374
Sugar	142.0	124
Whey powder	5.5	5.5
Salt	1.5	1.5
Sodium bicarbonate	0.5	0.5
Water	441.5	441.5
Vegetable oil	22.5	22.5
GRINDSTED™ CITREM LR 10 Citric Acid Ester	6.0	0
Delivery system *	0	24

* 26% GRINDSTED™ CITREM LR 10 and 74% HFCS

Procedure

- Heat oil and soya lecithin or GRINDSTED™ CITREM LR 10 to 40°C.

- Mix with the other ingredients at 2^{nd} speed for 3 min.
- Bake in a machine for ice cone wafers for 20 sec.

The performance of two different recipes was identical. An advantage of using the delivery system is that all the ingredient can be added at once, meaning that step 1 in the process can be left out due to the facilitated distribution of the emulsifier when incorporated in this delivery system. A further advantage of using the delivery system of the present invention is that when more than one functional ingredients is used, all the functional ingredients may be incorporated in the delivery system e.g. flavours, enzymes. Then only one product (the delivery system) has to be scaled instead of several minor ingredients.

EXAMPLE 12

ANOTHER INVENTIVE DELIVERY SYSTEM AND USES THEREOF

Meat Products

The delivery system of the present invention allows one to upgrade high-fat meat products.

Meat with a high fat content has a poor emulsifying capacity due to its low content of lean meat or to imbalances between salt soluble protein (mainly myosin) and collagen (known as short-meat). This also applies to meat batter that has been over-chopped, as the surface of the fat is increased to such an extent that the protein solution is unable to coat all of the fat particles. Even if the amount of salt soluble protein in the batter is sufficient to coat all fat particles with myosin, the reaction may only remain stable for a few hours unless it is heated.

The present emulsifier delivery system is capable of stabilising the batter or chunks over time, allowing the batter to be cooled or frozen for later heat treatment. The emulsifier prevents the meat from rendering before and during heating, which may

result in fat caps or fat pocketing.

In hot emulsified meat batter, an advantage of using a cold emulsifier delivery system in accordance with the present invention may be found in the processing step of cutting in the bowl chopper. The cold emulsifier system can be used instantly without any preceding processing steps contrary to traditional emulsifiers which have to be added to hot water the day before use to form a dispersed and homogeneous creamy mass.

Products

The present emulsifier system is suitable for various meat products, e.g. *hot emulsified products*, e.g. liver sausage and liver paté, and *cold emulsified products*, e.g. emulsion-type sausages such as ham sausage, bologna, mortadella, frankfurters, bockwurst and meat loaf. Furthermore, the emulsifier system can be used as a fat replacer for low-fat meat products to improve their emulsifying properties and to improve mouthfeel. The cold emulsifier system is particularly suitable for fresh meat, which is not heat treated prior to sale, e.g. reformed chicken, pork and beef for chops, steaks and burgers, etc.

Materials and methods

The below formulations are all based on traditional products commonly used within the meat industry.

1) Hot emulsified product: Liver Sausage (German style)

Ingredients:	*%*
Liver, Pork	20.00
Belly Fat	25.00
Belly Meat, bone-out	40.00
Nitrite, salt	0.36
Seasoning	0.38

Emulsifier delivery system *	1.15
Water (Soup) to	100.00

* 26% GRINDSTED™ CITREM M 12 and 74 % High Fructose Corn Syrup (HFCS).

Equipment: Mincer, bowl steam chopper (high speed), cooker.

Procedure:

Fat and meat are preheated in a cooker for 30 minutes at 95°C. The liver is minced through a 3 mm plate, and chopped in a bowl chopper at high speed. While chopping, salt is added and the blend is chopped until air bubbles are formed. The chopped liver is removed from the bowl chopper, and the bowl chopper is reset (0 (zero) rotations). The preheated belly fat and belly meat are added to the bowl chopper and chopped with the emulsifier at 65°C. After 80 rotations and at the temperature of 52°C, liver and seasoning are added. After 100 rotations the final temperature of 42°C is reached. The batter is filled into sterile artificial casings, and cooked at 75°C to an internal temperature of 72°C. The liver sausage is cooled by means of water and stored at 5°C.

A trial with the present delivery system has been conducted in a hot emulsified product, namely liver sausage (German Style), in accordance to the fomulation and procedure given above.

The results indicate that liver sausage made with the present delivery system is equal in texture and sensory appearance to that of a commercial liver sausage made with a traditional emulsifier such as GRINDSTEAD™ CITREM N12.

The use of the present invention is advantageous because easier technical handling during the production of the liver sausage is time saving, compared to the production of liver sausage with a traditional emulsifier such as GRINDSTEAD™ CITREM N12.

2) Cold emulsified product: Frankfurter

Ingredients:	%
Beef, Whole-carcass	20.00
Belly meat	20.00
Fat, pork	30.00
Nitrite, salt	1.00
Salt	0.90
Seasoning	0.80
Phosphate	0.25
Emulsifier delivery system *	1.92
Water/ice to	100.00

* 26% emulsifier and 74 % High Fructose Corn Syrup (HFCS).

Equipment: Mincer, bowl chopper (high speed), cooker/smoker.

Procedure:

Beef, pork and fat are minced through a 3 mm plate. Half the phosphate and half the salt are added to the beef and chopped in a bowl chopper. While chopping, half of the ice-water is slowly added. The chopping is continued until a good emulsion and the desired texture is obtained. The beef batter is removed from the bowl chopper and the pork is chopped according to the same procedure as the beef, i.e. the remaining phosphate and salt are added to the pork followed by the remaining ice-water, chopping continuously. When the desired texture of the pork mass is achieved, the beef mass is added. Fat, emulsifier and seasoning are added and the mass is chopped until it becomes glossy. The batter is filled into cellulosic or lamb casings linked in the desired sizes. The linked casings are placed around smoke sticks in loops. The smoke sticks are placed in a

cooking/smoking oven with sufficient space around them to allow a good air flow.

The procedure for the cooking and smoking is as follows:

Drying: 20 minutes at 70°C
Smoking: 60 minutes at 70°C
Cooking: 10 minutes at 78°C
Cooling: 10 minutes at 5°C by means of water.
Store at 5°C.

Meat products produced with the present emulsifier delivery system are equal in texture and sensory appearance to meat products produced with a traditional emulsifier.

The advantages of using the present delivery system is in the processing step of cutting the meat in the bowl chopper, as it is easier to apply to the meat batter than a traditional emulsifier and thus saves time in the production of emulsified meat products.

* * *

Having thus described in detail preferred embodiments of the present invention, it is to be understood that the invention defined by the appended claims is not to be limited by particular details set forth in the above description as many apparent variations thereof are possible without departing from the spirit or scope thereof.

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WHAT IS CLAIMED IS:

1. A delivery system for at least one emulsifier, which delivery system comprises an aqueous solution of at least one sugar, wherein the at least one sugar is selected from the group consisting of a monosaccharide, a disaccharide, a derivative of a monosaccharide, a derivative of a disaccharide, and combinations thereof.

2. The delivery system of claim 1 further comprising a deliverable substance other than the emulsifier.

3. The delivery system of claim 2 wherein the further deliverable substance is selected from the group consisting of hydrocolloids, flavourings, foodstuffs, enzymes, gums, starch, vitamins, sweeteners, functional proteins, salts, and mixtures thereof.

4. The delivery system of claim 2 wherein the further deliverable substance is in the form of a powder.

5. The delivery system of claim 3 wherein the foodstuffs include cocoa, herbs, mustard power, egg powder and mixtures thereof.

6. The delivery system of claim 1 wherein the emulsifier is a hydrated emulsifier in the form of an alpha-gel.

7. The delivery system of claim 1 wherein the sugar is a mono and/or disaccharide.

8. The delivery system of claim 1 wherein the sugar is a monosaccharide.

9. The delivery system of claim 1 wherein the sugar is dextrose or high fructose corn syrup.

10. The delivery system of claim 4 wherein the emulsifier is an amphiphilic food

emulsifier.

11. The delivery system of claim 4 wherein the emulsifier consists essentially of monoglycerides or mono-diglycerides.

12. An aqueous dispersion of at least one hydrated emulsifier in the form of an alpha gel comprising an aqueous solution of at least one sugar selected from mono- and/or disaccharides or derivatives thereof.

13. The dispersion of claim 12 wherein the sugar is a mono and/or disaccharide.

14. The dispersion of claim 12 wherein the sugar is a monosaccharide.

15. The dispersion of claim 12 wherein the sugar is dextrose or high fructose corn syrup.

16. The dispersion of claim 12 wherein the emulsifier is an amphiphilic food emulsifier.

17. The dispersion of claim 12 wherein the emulsifier consists essentially of monoglycerides or mono-diglycerides.

18. The dispersion of claim 17 wherein the monoglycerides or mono-diglycerides are distilled monoglycerides or mono-diglycerides.

19. The dispersion of claim 12 consisting essentially of about 15 to about 40 weight percent of the at least one emulsifier, about 42 to about 65 weight percent of the at least one sugar, and about 10 to about 20 weight percent of water.

20. The dispersion of claim 12 consisting essentially of about 15 to about 40 weight percent of at least one emulsifier consisting essentially of monoglycerides or mono-

diglycerides,
about 42 to about 65 weight percent of the at least one sugar and, about 10 to about 20 weight percent of water.

21. The dispersion of claim 12 consisting essentially of about 15 to about 40 weight percent of at least one emulsifier consisting essentially of monoglycerides or mono-diglycerides, about 42 to about 65 weight percent of high fructose corn syrup, and about 10 to 20 weight percent of water.

22. The dispersion of claim 12 additionally containing at least one of: an ionic co-emulsifier and an alpha-tending emulsifier.

23. The dispersion of claim 22 wherein the ionic co-emulsifier is DATEM, CITREM or sodium stearoyl lactylate, and the alpha tending emulsifier is polyglycol ester(s), propylene glycol ester(s), or sorbitan monostearate.

24. The dispersion of claim 12 wherein the emulsifier is present in an amount of about 26 to about 30 weight percent.

25. A foodstuff obtainable from or prepared with the delivery system of claim 1.

26. A foodstuff obtainable from or prepared with the emulsifier dispersion of claim 12.

27. A method for preparing a dispersion of claim 12 comprising admixing the at least one emulsifier, the at least one sugar and the water at a suitable temperature for formation of the lamellar mesophase, and cooling to a suitable temperature for formation of the alpha gel.

28. The method of claim 27 wherein the admixing is at about 55° to about 80°C. --

29. The method of claim 27 comprising blending the emulsifier at about 55° to about 80°C, and adding the sugar and water with mixing at a temperature of about 55° to about 80°C.

30. The method of claim 27 wherein sugar and water are added in an amount to establish an emulsifier content of about 25 to 60 weight percent.

31. In a method for making a foodstuff wherein the improvement comprises using the dispersion of claim 12.

32. The method of claim 31 comprising plating the dispersion onto dry ingredients.

33. Use of a sugar as a delivery system for an emulsifier, wherein the sugar is any one or more of a monosaccharide, a disaccharide, a derivative of a monosaccharide, or a derivative of a disaccharide.

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/IB 98/01882

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A23L1/035 A23L1/09 A21D2/18 A21D2/16 A23P1/04
A23L1/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A23L A21D A23P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 317 839 A (MITCHELL WILLIAM A ET AL) 2 March 1982 see column 2, line 20 - column 3, line 15 see column 5, line 16 - column 6, line 32 see column 6, line 60 - line 68 ---	1-4,7,9, 10,25,33
X	US 3 479 189 A (VRANG CARL ET AL) 18 November 1969 see column 3, line 14 - column 4, line 23 see column 6, line 44 - line 66 see column 7, line 5 - line 24 ---	1-3, 6-18,22, 24,26-33
X	US 4 168 323 A (INAMINE SHIGEO ET AL) 18 September 1979 see column 1X, line 50 - column 2, line 62 see column 3, line 1 - line 11 see examples 6,9,21 --- -/--	1-3,7-9, 11,25,33

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 March 1999	22/03/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Vuillamy, V

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INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/IB 98/01882

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	US 4 835 002 A (WOLF PETER A ET AL) 30 May 1989 see column 2, line 25 - column 8, line 55 see column 11, line 4 - column 13, line 40	1-3,6-33
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IB 98/01882

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